



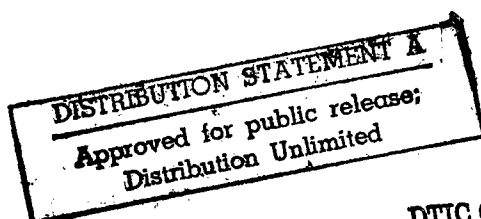
**FOREIGN  
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# ***JPRS Report***

## **Science & Technology**

***Central Eurasia:  
Electronics & Electrical Engineering***

19980114 178



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# Science & Technology

## Central Eurasia: Electronics & Electrical Engineering

JPRS-UEE-92-012

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4 December 1992

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**International Conference on Electrography  
"Electrography 91"**

937K0004C Moscow *ZHURNAL NAUCHNOY I  
PRIKLADNOY FOTOGRAFII I KINEMATOGRAFII*  
in Russian Vol 37, No 3, May-Jun 92 pp 253-254

[Article by A. B. Dravin, Yu. A. Cherkasov; UDC  
772.93]

[Abstract] An International Conference "Electrography-91" was held near Moscow between October 22 and 25, 1991. This conference was organized jointly by the USSR Ministry of the Radio Industry and the Moscow Scientific and Industrial Association "Gamma". More than 180 representatives of scientific research institutes and industrial enterprises from the Commonwealth countries took part in the conference. Many reports were presented, dealing with the fundamental problems of electrography, including the electro-photographic process, equipment and materials. The other topics concerned micrography, electrophotographic and electrographic printing devices as well as the non-organic and organic electrophotographic layers, photothermoplastic processes, equipment and materials. It was pointed out that in general, the state of the electrography in the Commonwealth States is characterized as follows: The scientists and industrialists do not constitute a united scientific and technical force, and the instrument stock consists mostly of imported equipment. If a commercial approach is not assumed in the near future, various scientific projects will have to be cancelled. The problem of developing defectless layer technology is still not resolved. Although the domestic layers are frequently superior to foreign in terms of light sensitivity, the foreign layers contain fewer defects and are more uniform. The technology is not being developed using contemporary ideas. The level of the design technology is low, while the instrument's theory is good.

**Pulsed Laser Recording of the Interference  
Pattern on a Photothermoplastic Medium**

937K0004B Moscow *ZHURNAL NAUCHNOY I  
PRIKLADNOY FOTOGRAFII I KINEMATOGRAFII*  
in Russian Vol 37, No 3, May-Jun 92 pp 242-244

[Article by V. I. Anikin, I. V. Dementyev, I. L. Zhurminskiy, L. M. Panasyuk, Moldova State University; UDC  
778.38]

[Abstract] This article reports the results of studies on recording the interference pattern of vibrating objects on a two-layered photo-thermoplastic (PTP) medium with a photo-sensitive layer on the  $As_2Se_3$  -  $As_2S_3$  heterostructure base and with a thermoplastic layer of butyl methacrylate copolymer with styrol using a stroboscopic method. The interference pattern was recorded employing the classical off-axis method. A single mode ruby system with a passive Q-factor modulation was used for the experiment. A circular steel plate, which was excited by an acoustic wave, served as a test object.

Studies of the oscillating steel plate frequency characteristic indicate a presence of sharply expressed resonance in its oscillation spectrum. With an increased amplitude of the induced oscillations of the plate, the number of stripes in the interferometer is increased, and their contrast is reduced. The feasibility of recording the holographic interference pattern of a fast process by a stroboscopic method on a two-layered PTP medium using a simultaneous recording method was demonstrated. Figures 2, references 12: 10 Russian, 2 Western.

**Real Time Holographic Photography**

937K0004A Moscow *ZHURNAL NAUCHNOY I  
PRIKLADNOY FOTOGRAFII I KINEMATOGRAFII*  
in Russian Vol 37, No 3, May-Jun 92 pp 204-210

[Article by O. V. Sakhno, T. N. Smirnova, Ye. A. Tikhonov, Ukrainian Academy of Sciences Institute of Physics, Kiev; UDC 778.38]

[Abstract] A method for producing a real-time photographic image on layers of photo-polymerized composites (PPC) is discussed. The method is based on recording the speckle-field holograms obtained by illuminating the photographed objects with a coherent light. The nature of the phase heterogeneities which form the photographed image is shown to be holographic. The image can be visualized due to spatial modulation of the intensity of non-coherent light scattered by the heterogeneities. Photographic images are obtained with the PPC-488 material, which was developed for the holographic phase recording. Sensitometric characteristics of the PPC-488 recording layers are examined. It is demonstrated that the method can be used for reproduction. Procedures for optimizing the photographic process using the developed recording material are proposed. Figures 5, references 18: 12 Russian, 6 Western.

**Eight-Digit Analog to Digital Converters**

937K0029C Moscow *RADIO* in Russian  
No 7, Jul 92 pp 41-44

[Article by B. Matantsev]

[Abstract] Microprocessors are more and more frequently used with amateur radio designs. As a rule, the microprocessors receive data from analog signal sources using analog to digital converters (ADC). The industry manufactures some models of the ADC, but they are hard to obtain and difficult to adjust. A relatively simple and easily constructed ADC was developed and is described here. The speed of this ADC is adequate for functioning with contemporary microprocessors and it can be used for many applications where a very high accuracy is not required. The fundamental engineering characteristics of this ADC are listed, and the electrical circuit diagram is provided. The ADC is designed for

operation with an eight-digit MP KR580IK80A, or a similar microprocessor. Procedures for the ADC calibration are described.

### High Frequency Millivoltmeter With a Linear Scale

937K0029B Moscow RADIO in Russian  
No 7, Jul 92 pp 39

[Article by A. Pugach]

[Abstract] Diode rectifiers, in the negative feedback circuit of the ac amplifiers, are normally used for voltmeters with a linear scale. In addition to rigid design requirements, these devices are very complex, and need parts which are difficult to obtain. However, there are simple millivoltmeters available with a non-linear scale. These instruments are wideband, have a high input impedance and a small input capacitance, but the indications must be converted to find the true value. A device for changing the scale of such millivoltmeters to a linear one was developed. This device is described and a block diagram of the electrical circuit is provided. Voltages in the 2.5 mV - 25 V interval using 11 sub-ranges can be measured by this millivoltmeter, which was also fabricated by the author. The operating frequencies lie in the 100Hz - 75MHz range, and the measurement error is not greater than 5%. Figures 2.

### Operational Prediction of Signal Transmission Conditions

937K0029A Moscow RADIO in Russian  
No 7, Jul 92 pp 4-5

[Article by G. Lyapin]

[Abstract] Radio-beacons are used in professional radio communication practice. These are continuously operating low-power transmitters, regularly transmitting by telegraph one or two letters. Knowing in advance the location of the beacon, and by monitoring its performance, the transmission conditions at a given moment along a particular path and at frequency close to the frequency of the beacon can be determined with great certainty. This method can be successfully used to determine the DX of transmission of broadcast signals in the SW, and for using the transmitters of standard time and frequency as beacons. These beacons are employed in different countries, as well as in ours. Guidelines and recommendations for using the beacons are provided and some operating beacon frequencies are listed.

### Network Voltage and Life-Time of Low-Power Sodium High-Pressure Lamps

937K0013A Moscow SVETOTEKHNIKA in Russian  
No 7-8, Jul-Aug 92 pp 2-3

[Article by V. M. Ivanov, G. M. Kozhushko, O. G. Koryagin; UDC 621.327.532-987(088.9)]

[Abstract] Studies were conducted to determine the effect of various factors on the life-span of the DNaT-100 type low-power Sodium lamps. It was demonstrated that the increased voltage of the power supply line is the most significant factor that reduces the lamp's service-time. This fact was reported in the foreign and domestic publications, but there is very few direct experimental data in the literature on the relationship of the service-time as a function of changes in the line voltage. The test objective was to determine the characteristic of the lamps operating under three different fixed values of the voltage: 200, 220 and 240 volts. It was demonstrated that with line voltages of 240 V, the service time of lamps with burners without exhaust tubes was reduced by fifty percent. Earlier published data, with reference to the Ivasaki company, stating that the service time of the Sodium lamps is reduced by lowering the line voltage because of the increase time needed for ignition and heating up was not supported by the experiments. The service time of the sodium lamps can be extended by improving the stability of the line voltage. Figures 4, references 5: 4 Russian, 1 Western.

### Ways To Reduce the "Switching On" Cost of the Incandescent Lamps

937K0013B Moscow SVETOTEKHNIKA in Russian  
No 7-8, Jul-Aug 92 pp 10-11

[Article by N. P. Kiseleva, V. S. Litvinov; UDC 621.326.032.32.001.24]

[Abstract] The "switching on" cost represents the decrease of the life-time of lamps operating in the frequent switching-on mode, compared to a continuous burning, referred to an average number of switching on, endured by the lamps before a breakdown. While the "switching on" cost reflects changes in the life-time of the lamps, it depends on many factors, including the temperature, duration of the switching cycle, and other factors. These factors were investigated with general purpose incandescent lamps, projector lamps, etc. The results of this study are listed in tables. It was demonstrated that the performance of the general purpose lamps operating in a frequent switching-on mode is characterized by several features indicating a specific character of the lamps breakdown. Primarily, it is manifested by a degradation of important operating parameters, luminescence and increased consumed power. Tables 3, references 4 Russian.

**Computer Aided Design of Optical Lighting Systems**

937K0013C Moscow SVETOTEKHNIKA in Russian  
No 7-8, Jul-Aug 92 pp 13-16

[Article by Ye. F. Ishchenko, N. V. Zhilenkova, A. V. Burov; UDC 628.946.001.24]

[Abstract] Computer aided design methods for optical electric light systems were developed in the Physics Department of the Moscow Energy Institute and implemented together with the Design Bureau of the Moscow Electric Lamp Factory. There are two types of design problems: direct and inverse. The direct problem deals with determination of the output characteristics of the devices from specified characteristics of the radiator and the optical system. In the inverse problem, the parameters and the required output characteristic are specified, and the optimal optical characteristic must be determined. For most real devices an unambiguous solution of the inverse problem is difficult. In the developed system of automatic design, the inverse problem is solved by a quick scanning of various solutions of the direct problems in a dialog mode, followed by an expert estimate of the results. Suitability for computer processing were the prime criteria in selecting the methods for the solution of the direct problem. Full algorithms were developed for the system of automatic design and its consecutive stages are discussed. Figures 4, references 2 Russian.

**Mechanized Manufacturing of the High-Pressure Lamp Bulbs**

937K0013D Moscow SVETOTEKHNIKA in Russian  
No 7-8, Jul-Aug 92 pp 19-21

[Article by A. P. Sivko; UDC 621.32.002:621327.534.25]

[Abstract] In order to develop optimal construction of gas-heated furnaces and to assure a proper selection of feeders and forming equipment for processing SL40-1 type glass, the mechanism of the molten glass behavior in the process of manufacturing lamp bulbs was thoroughly studied. Reasons for the origin of defects and nonuniform distribution of glass when the bulbs are formed were investigated. It was demonstrated that any borosilicate glass-mass exhibits high gas solubility, which depends on the atmospheric pressure in the furnace, and that the dissolved gases are responsible for formation of small bubbles. The glass must be heated to a temperature of 1580-1600°C, because at lower temperatures gases cause an incomplete fining of the glass. A high efficiency gas furnace was developed for production of the SL40-1 type hard glass and mechanized manufacturing of bulbs for high-pressure discharge lamps. The engineering specifications of the furnace are provided. Figures 2, tables 3, references, 3 Russian.

### **Deterioration of the Moving Targets Detection Efficiency When the Wideband Properties of the Received Signals Are Not Taken Into Account**

937K0007M Kiev IZVESTIYA VYSSHIKH  
UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA  
in Russian Vol 35, No 3-4, Mar-Apr 92 pp 77-80

[Article by G. S. Nakhmanson; UDC 621.391]

[Abstract] When solving the moving targets detection problem, transformation of the reflected signal envelope time scale due to the target motion is normally not taken into account. With space-time processing under interference conditions, this can cause significant losses in accuracy of estimating the range and radial velocity of the targets, which increase with increased coefficient of the signal bandwidth compression. Examined in this paper is the detection of a moving target by a non-coherent burst of fluctuating pulses with internal modulation, reflected from the target and received in the background of normal non-correlated noise with a specified spectral density by a multiposition radio system with several receiving elements. Based on the obtained results, the dependence of the moving target detection characteristics deterioration, because the time scale transformation of the received signal envelopes was not taken into account, can be described as a function of the signal parameters and the target speed. Figure 1, references 2 Russian.

### **Computation of the Vector for Space-Time Processing of a Coherent Pulse Burst**

937K0007L Kiev IZVESTIYA VYSSHIKH  
UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA  
in Russian Vol 35, No 3-4, Mar-Apr 92 pp 74-76

[Article by Yu. V. Ivanov; UDC 621.396.96]

[Abstract] Optimal space-time processing of a pulse burst, which realizes a maximum signal-to-interference + intrinsic noise is discussed. For the reduction of computations and hardware expenditure, a matrix factorization by diagonal matrices is proposed. Expressions are obtained which would simplify the procedure of computing the weight coefficient vector of the space-time filter for the case of a single random and several determined interferences. References 3 Russian.

### **Information Yielding Properties of the Complex Envelope of the Reflected Signal**

937K0007K Kiev IZVESTIYA VYSSHIKH  
UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA  
in Russian Vol 35, No 3-4, Mar-Apr 92 pp 59-65

[Article by Ye. I. Sedykh; UDC 621.396.967]

[Abstract] The objective of the contemporary high-efficiency radar systems synthesis is a development of the reflected signal models, which would account for the specific features of the scattering properties and, in

particular, the scintillation noise of real targets. Little is available in the scientific literature on extraction of structural information from the complex envelope of the echo-signal which describes the character of the radar target scintillations. This paper examines the question of how and to what extent structural information can be extracted from the complex envelope of the reflected signal. General expressions of an arbitrary order cumulative functions are analytically determined for the complex envelope of the radar signal scattered by a complex target. References 5: 4 Russian, 1 Western.

### **Efficiency Analysis of Algorithms for a Space-Time Processing With Wobulation of the Repetition Period**

937K0007J Kiev IZVESTIYA VYSSHIKH  
UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA  
in Russian Vol 35, No 3-4, Mar-Apr 92 pp 38-43

[Article by Yu. V. Ivanov, D. N. Kolpakov, I. K. Rakova; UDC 621.396.67.01]

[Abstract] Relationships are obtained for a covariant interference matrix and a weight coefficient vector of an optimal filter for space-time processing, exhibiting properties of adaptive antenna arrays and adaptive moving target selection filters. A comparison is made between the characteristics of an optimal space-time algorithm, which maximizes the signal-to-interference + intrinsic noise ratio, and the algorithm with a sequential optimal processing in space and time. The analysis of the algorithm's efficiency indicates the following advantages of the optimal algorithm for space-time processing over the traditional sequential algorithm for a separate optimal processing in space and time: possibility of the signal separation from noise when any of the two parameters, either the doppler frequency, or direction to the signal source and noise are available; reduction in irregularities of the speed characteristic; and possibility of reducing the number of analog-digital modules with a simultaneous increase in the order of the optimal filter for space-time processing and the number of pulses in the reflected burst. Figures 3, references 7 Russian.

### **Threshold Signal-to-Noise Ratios With Detection of Random Signals**

937K0007I Kiev IZVESTIYA VYSSHIKH  
UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA  
in Russian Vol 35, No 3-4, Mar-Apr 92 pp 32-37

[Article by Yu. S. Lezin; UDC 621.391.26]

[Abstract] The probability of false alarm and correct signal detection is determined for optimum separation of random noise signal from noise interference. Curves are constructed of the threshold signal-to-interference ratio as a function of the product of the input filter's transmission band by the integration length of the received signals, for two probability values of correct detection, and four probability values of false alarm.

Computations are made of the errors in the threshold signal-to-interference ratios with the gaussian approximation of the output voltages. It was demonstrated that this approximation is applicable only for a sufficiently large value of the above product. In this case, when the above product increases, the threshold signal-to-interference ratio is decreased in inverse proportion to the fourth root of this product. Figure 1, tables 2, references 6: 3 Russian, 3 Western.

#### **Effectiveness of Double Polarized Signals With Adaptive Suppression of Interfering Reflections**

937K0007H Kiev IZVESTIYA VYSSHIKH  
UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA  
in Russian Vol 35, No 3-4, Mar-Apr 92 pp 26-31

[Article by M. F. Babakov, N. V. Savchenkov; UDC 621.396.96]

[Abstract] Polarization differences between a signal reflected from targets and a signal reflected from interfering reflections (IR) can be used for improving their power ratio. The polarization characteristics (PC) of signals from the targets and from the IR, obtained at large time intervals, are weakly correlated and can not provide an effective interference suppression. At short time intervals, the PC of IR exhibit a high degree of polarization, which can be used for employing adaptive methods for polarization selection. The efficiency is determined of the adaptive polarization selection when a double polarization is used as a probing signal. A fluctuating polarization scattering matrix (PSM) model was used for the analysis of orthogonal polarized components. It was shown that the employment of the double polarized probing signals with separation of the PSM elements at reception, provides the same signal-to-noise ratio as is achieved by optimizing the polarization of radiation and reception. Thus, employment of the double polarized probing signals provides the adaptive polarization selection with adaptation only at the reception. Figures 3, references 2 Western.

#### **Analysis of Multipurpose Radar Systems Potentials for Remote Probing of the Earth From Space**

937K0007G Kiev IZVESTIYA VYSSHIKH  
UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA  
in Russian Vol 35, No 3-4, Mar-Apr 92 pp 18-25

[Article by A. I. Kalmykov, O. V. Sytnik, V. I. Tsymbal; UDC 621.396.96]

[Abstract] This study discusses the optimization problem of radar equipment located on board orbital vehicles with the purpose of improving the information yielding capacity of the monitoring system and increasing its functional range. The existing and perspective radar systems for remote probing of the Earth from

space are analyzed. A generalized criterion of the system's optimal characteristic is proposed, where the optimization is based on the maximum information yielding capacity criterion, under specified limitations of the system engineering parameters. The proposed system would offer a solution to a wide range of problems dealing with the remote sensing of the ocean, ice and land. Employment of a two-frequency radar systems operating in the 3...5 and 20...30 cm wave length range would be most efficient for studying the sea surface heterogeneities in the shelf. Figures 2, table 1, references 14: 6 Russian, 8 Western.

#### **Generalized Criterion of Interference Suppression With Quasi-Coherent Reception of Discrete Messages in Randomized Radio Links**

937K0007F Kiev IZVESTIYA VYSSHIKH  
UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA  
in Russian Vol 35, No 3-4, Mar-Apr 92 pp 12-17

[Article by V. V. Bortnikov, M. A. Voznyuk, Yu. Zh. Onishchenko; UDC 621.391.23.019]

[Abstract] Within the framework of the optimal non-linear filtering theory of Markov processes and by applying a generalized criterion, an analysis is made of the interference suppression features of quasi-coherent distributed reception of frequency modulated signals for a statistically uniform channel with a random gain, a specified initial phase of the high frequency signal carrier, and a given time-delay. A wideband signal, formed by a binary pseudo-random sequence in conjunction with the pseudo-random retuning of the frequency, is used as a model. Analysis of the quasi-coherent receiving devices quality, using a generalized criterion of the noise rejection, produces objective estimates of their efficiency. The results of the analysis for a transient filtering mode are shown in graphs, which indicate that while the qualitative relationships are retained, a significant deterioration of the generalized criterion is observed, compared to a particular index of the interference suppression. Figure 1, references 6 Russian.

#### **Estimates of the Digital Devices Capacity in Processors for Adaptive Spatial Processing**

937K0007E Kiev IZVESTIYA VYSSHIKH  
UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA  
in Russian Vol 35, No 3-4, Mar-Apr 92 pp 4-11

[Article by V. V. Zakharov; UDC 621.391.26]

[Abstract] Methods are proposed for estimating the capacity of digital devices (weight coefficient vector, analog-to-digital converter, the processor's arithmetic devices) for algorithms with direct conversion of the most probable estimates of the correlation matrix (CM), with regulated estimates of the CM, and with a recurrent conversion of the regulated estimates of the CM. The derived expressions indicate that dimension of the

phased array control electronics (PACE), interference-to-noise ratio at the PACE input, and the regulation parameter constitute the parameters which determine the requirements for the digital device's capacity. A comparison of the algorithms was made for the required capacity of the weight coefficient vector and the analog-to-digital converter. Figure 3, table 1, references 8: 3 Russian, 5 Western.

#### **Correlation Properties of Single Minimum-Phase-Shift Frequency Modulated Signals**

937K0007D Kiev IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 35, No 3, Mar 92 pp 51-56

[Article by O. P. Ozerskiy, L. P. Kuklev; UDC 621.396.96]

[Abstract] The correlation properties of single minimum phase shift frequency modulated signals (MFM) are examined and differences of its envelope, compared to the autocorrelation function (ACF) producing the binary code, are revealed. The signals are formed by different methods from an identical binary code, while four different MFM-signals with dissimilar envelopes of the autocorrelation function correspond to each binary code. The envelope shape of the ACF MFM-signal, formed by any of the rules described here, does not coincide with the shape of the ACF modulus that produces the binary code. Here, the principal peak of the ACF MFM-signal envelope is wider than the principal peak of the binary code ACF by a factor of 1.4...1.9, and has a smaller slope. Figures 4, references 2 Russian.

#### **Signal Classification Using Information on the Difference in Relative Speed of the Subscribers Motion**

937K0007C Kiev IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 35, No 3, Mar 92 pp 37-45

[Article by E. A. Ibatullin; UDC 621.391.26]

[Abstract] When operating two functionally and statistically tied radioelectronic systems for extracting information, a situation can occur in practical applications when signals cannot be classified by determining their unknown parameters using regular methods. There are events when the systems operate with a single subscriber, and events when the systems operate with different subscribers. It was shown that information on the difference of the relative speed of the primary and the secondary system's motion can be effectively used for distinguishing the two events. Based on this information,

a synthesis was carried out for an optimal deciding rule of the signal classification. Expressions were obtained for probabilities of correct and incorrect signal classifications; the validity and unbiased condition of the deciding rule was demonstrated. Figures 2, references 5 Russian.

#### **Nonlinear Boundary Conditions at the Contact Points**

937K0007B Kiev IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 35, No 3, Mar 92 pp 30-37

[Article by B. M. Petrov; UDC 537.874.72.01]

[Abstract] Nonlinear boundary conditions are obtained to study the biharmonic impact of electromagnetic field sources on artificial or natural nonlinearities, with known volt-ampere characteristics, located on a metallic body. These conditions link together an infinite number of harmonics of the electrical and magnetic currents on the nonlinearities. The mathematical model of the nonlinear contact leads to nonlinear impedance boundary conditions, which in contrast to the linear impedance boundary conditions, are determined not by the electrodynamic parameters of the contact medium, which are unknown for the contacts with a natural origin, and which can not be determined for the artificial contacts, but by the electrophysical parameters of the nonlinearities. Figures 1, references 4 Russian.

#### **Balanced Excitation of Conical Slotted Waveguides**

937K0007A Kiev IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 35, No 3, Mar 92 pp 3-9

[Article by D. B. Kirilyak; UDC 621.372]

[Abstract] Balanced excitation of a perfectly conducting cone with a finite number of azimuthal slots is examined by applying the eigenfunction method. Infinite systems of linear algebraic equations of the second kind are derived. These systems of equations provide a convenient basis for an analytical and numerical study of excitation of conical slotted waveguides. This approach can be readily generalized for analysis of other structures with conical boundaries. Problems of waveguide excitation by an H-polarized wave, and similar acoustic problems with an in advance specified accuracy, can also be solved. They are valid for any relationships between the parameters of the problem, and an approximate analytical solution can be obtained in the low frequency region. Particular solutions are analyzed, and problems related to the boundary transition to the disk structures are also examined. Figures 2, references 5 Russian.

**Packet Data Transmission in Multichannel Mobile Radio Communication Systems**

937K0014A Moscow *RADIOTEKHNIKA in Russian*  
No 3, Mar 92 pp 5-10

[Article by O.A. Shorin, M.V. Fedulov; UDC 621.396.931.031]

[Abstract] Transmission of digital data along with analog in multiple access multichannel systems in the form of individual packets and the issue of increasing the system capacity by freeing it from transmission of analog data and multiplexing it with data packets are considered. An attempt is made to determine the possibility of ensuring packet data transmission in a combined radio channel without increasing the user queues, i.e., finding the ergodicity conditions of the data transmission processes which assume that the mean queue length of individual user packets is limited. The problem is formulated and a block diagram of the communication system is cited. The solution is found in the case where all users are under equal conditions (there are no priorities) and all free channels are seized equiprobably. An analysis of a discrete Markovian chain which describes the status of a mobile radio communication system in the multiple random access mode under ergodicity conditions in a multichannel operation shows that for certain parameters, it is not necessary to allocate individual channels for digital data transmission but use multiple random access to the freed channels; this increases the system capacity. The resulting formulae make it possible to perform engineering analyses of the requisite system variables. Figures 1; references 2.

**Kalman Filtering Equations for Pseudotriangulation Ranging Systems**

937K0014B Moscow *RADIOTEKHNIKA in Russian*  
No 3, Mar 92 pp 10-13

[Article by Yu.G. Bulychev, I.V. Burlay, V.A. Motorkin; UDC 621.396.96]

[Abstract] A new method of ranging a target by the goniometric data of a mobile direction finder is considered. Since it is developed as an alternative to the well-known triangulation evaluation method and is similar to it in some ways, it is often referred to as pseudotriangulation ranging. General Kalman filtering equations of the trajectory parameters for a pseudotriangulation ranging system are derived. Since they do not depend on the slant range, they can be used for determining the coefficients of the undisturbed target path model. The unknown vector of the model parameters is found by solving a system of linear algebraic equations. The problem of optimum range finder motion control synthesis is reduced to designing a range finder control which minimizes the target angle norm at any moment. References 6.

**Corrector for Decreasing Electromagnetic Field Measurement Error**

937K0014C Moscow *RADIOTEKHNIKA in Russian*  
No 3, Mar 92 pp 14-17

[Article by R.I. Rumyantsev; UDC 537.8]

[Abstract] The shortcomings of circuits consisting of waveguide sections linked by articulated joints (VS) used for measuring the electromagnetic field characteristics and determining the compatibility conditions aroused interest in similar circuits with flexible cables (TGK); yet the latter's shortcomings, i.e., a high signal amplitude and phase fluctuation level at a random strain during scanning prompted the development of a corrector for decreasing the electromagnetic field measurement error. The method of measuring the phase and amplitude fluctuations is outlined and the design of the correcting device is described. The corrector ensures that the flexible feeder cable has a certain tension at all times. The random amplitude and phase fluctuations are corrected in two stages: first, the circuit with the flexible cable is substituted with a cable with a tensioning corrector; then the correcting unit takes multiple amplitude-phase error measurements at each working frequency, the measurement results are statistically processed on a computer, and these data are taken into account in measuring the amplitude-phase distribution of the device (i.e., antenna) being tested. The corrector makes it possible to lower the random error in near field measurements with the help of a scanner with a flexible cable and meet the metrological requirements imposed on the electromagnetic field representation. Figures 2; references 2.

**Simulation of Aircraft Trajectory Instabilities on SAR Characteristics**

937K0014D Moscow *RADIOTEKHNIKA in Russian*  
No 3, Mar 92 pp 39-43

[Article by V.I. Priklonskaya; UDC 621.396.96]

[Abstract] The behavior of synthetic aperture radar characteristics in a real aircraft (LA) flight vs. its trajectory instabilities (TN) and SAR input signal phase distortions (FI) are discussed and an attempt is made to simulate on a computer (EVM) the synthetic aperture radar (RSA) output signal in a real carrier trajectory in order to assess the effect of the aircraft trajectory instabilities on the resolution, azimuth measurement accuracy, and resolution variation under a noncoherent image accumulation. A formula is derived for calculating the SAR response to a single point target, i.e., the synthetic radiation pattern (SDN), and the method of evaluating the radar resolution on the display using airborne instrumentation (BII) and data is outlined. The major lobe (GL) shift of the synthetic radiation pattern relative to the real antenna radiation pattern (DN) as a result of the trajectory instabilities and the mutual shift of target returns on the radar image (RLI) are plotted and the results of computer simulation of an output SAR signal over a 15 s flight segment at given parameters are

presented. The dependence of the relative beamwidth on the synthesis interval number is plotted. It is shown that the SAR response to a single point target calculated by the antenna phase center (FTsA) realization can be used to assess the effect of path instabilities on the SAR resolution; the appearance of a major lobe "pedestal" with square-law phase distortions leads to a nonmonotonic character of the resolution probability behavior. Formulae are derived for analyzing the effect of the trajectory instabilities on the target azimuth measurement in the radar image or on the degree of SAR resolution variation under noncoherent image accumulation. Figures 3; references 4.

#### Assessing Depth of Amplitude Modulation of Noise by Random Signal

937K0014E Moscow *RADIOTEKHNIKA in Russian*  
No 3, Mar 92 pp 44-46

[Article by L.M. Gelman; UDC 621.391.883.2: 621.376.2]

[Abstract] The depth of amplitude modulation (AM) of wide-band noise by a harmonic signal, particularly a random modulating signal in the presence of noise, are discussed and an attempt is made to estimate the depth of amplitude modulation of wide-band noise—received through continuous wave jamming—by a random signal. The amplitude modulation process is considered as steady-state Gaussian centered noncorrelated wide-band carrier and noise and a narrow-band modulating signal with known center frequency, carrier variance, and partial modulation depth and signal variance. The maximum likelihood estimate of the spectral density of the process is derived; the signal detector is assumed to be an instantaneous, quadratic, full-wave detector. The case where the AM depth does not exceed 0.3-0.4 is considered. The maximum likelihood estimate variance is expressed as a function of the signal:noise ratio and process parameters. The resulting formulae make it possible to evaluate the depth of AM of wide-band Gaussian noise received through wide-band CW noise by Gaussian narrow-band signals. References 9: 8 Russian, 1 Western.

#### Detection Error Probability of Signal Distorted by Multiplicative Noise

937K0014F Moscow *RADIOTEKHNIKA in Russian*  
No 3, Mar 92 pp 50-52

[Article by D.Sh. Agrba, V.I. Yesipenko; UDC 621.391.82]

[Abstract] The effect of selective circuits (ITs) is considered and the error probability of digital message transmission systems (SPDS) in detecting a signal distorted by dominant multiplicative noise in the form of a harmonic oscillation with a random initial phase is determined using the "amplitude detector (AD) of  $v$ -degree and RC integrator with a synchronous discharge" element. The

assumptions underlying the error analysis are outlined and a formula is derived for calculating the amplitude detector output voltage. The two most common types of selective circuits are examined in detail: single resonance tuned circuits and single pairwise-detuned circuits or stages with two-circuit band-pass filters. The findings are illustrated by computer graphics for various parameter values and compared to the results produced in published sources. The expediency of using  $v \geq 2$  is noted. References 2.

#### Radiation Pattern of Spatially Fed Round Antenna

937K0014G Moscow *RADIOTEKHNIKA in Russian*  
No 3, Mar 92 pp 66-67

[Article by I.V. Golovin, G.A. Polukhin; UDC 621.396.67]

[Abstract] The shape of the amplitude distribution in the aperture of a round antenna with a spatial feed and optimum power distributor is discussed and an attempt is made to theoretically assess the radiation pattern and the antenna aperture efficiency (KIP) of a round antenna with an optimized spatial feed whose experimental distribution is approximated by a power function. The formulae of the amplitude distribution of the radiating pattern (DN) and the antenna aperture efficiency are derived and the amplitude distribution and the dependence of the antenna beamwidth at a -3 dB half-power and side lobe level on the amplitude distribution shape are plotted. The resulting relationships make it possible to estimate the round antenna's DN and KIP with a close to  $\Pi$ -shaped amplitude distribution. Figures 3; references 4.

#### Screened Dielectric Waveguide Modes

937K0014H Moscow *RADIOTEKHNIKA in Russian*  
No 3, Mar 92 pp 73-76

[Article by A.V. Gureyev; UDC 621.372.8]

[Abstract] The pattern of variational dependence of the natural wave propagation factors of screened unevenly filled waveguides on the frequency, geometrical, electric, and magnetic parameters of the filling medium as a function of the degeneracy singularities of certain modes is discussed and the properties of natural modes are analyzed and classified for a dielectric waveguide (EDV) without losses screened by a perfect conductor based on the dependence of the propagation factor on the structure parameters. The dependence of this waveguide's normalized propagation factors of the four lowest traveling and below-cutoff modes on the waveguide filling factor, relative dielectric permittivity of the rod, relative magnetic susceptibility, and various values of the normalized frequency parameter are plotted. An analysis of the findings reveals that the dielectric waveguide's natural modes can be classified as screen modes which are close to H-modes in properties, coaxial modes which are close to below-cutoff E-modes, dielectric modes which

may be close to surface H- and E-modes or below-cutoff E-modes from the magnetic side face, and composite modes. Some modes are transformed into others under certain combinations of parameters within a narrow range. The case of filled lossy dielectric waveguides is considered. Figures 2; references 5.

### Spectral Response of Static Noise Signal Dipole

937K0014I Moscow *RADIOTEKHNIKA in Russian*  
No 3, Mar 92 pp 76-77

[Article by O.N. Maslov; UDC 621.396.67]

[Abstract] The principles of analyzing the spectral characteristics of the wave field of static noise signal dipoles, viz., the dipole's spectral radiation patterns (DN) and the energy spectrum (ES) of the field strength, are considered. The dipole field structure in the Fraunhofer and Fresnel zones is investigated on the basis of the general solution of a system of Maxwell's equations of an elementary electric radiator (EEI). The frequency-nonuniform energy spectrum of the current driving the radiator corresponds to the hyperbolic sine law for a dipole with a random length. The boundary between the Fresnel and Fraunhofer zones is defined. It is suggested that the load-matched oscillator's output signal energy spectrum and antenna feed line gain be determined experimentally with the help of, e.g., panoramic signal power meters and matching meters. It is noted that the energy spectrum is transformed in both zones due to the nonuniformity of the oscillator-matched radiator energy spectrum as a result of the directional properties of the dipole.

### Mathematical Model for Analyzing Mean UHF-VHF Field Attenuation in Forests

937K0014J Moscow *RADIOTEKHNIKA in Russian*  
No 3, Mar 92 pp 78-79

[Article by A.N. Kulikov, A.L. Magazinnikov; UDC 621.391.812.8]

[Abstract] Extensive development of mobile communications systems for various purposes increases the urgency of understanding the UHF-VHF radio wave propagation in the forest and in particular, the energy characteristics of the UHF-VHF field. A model of wooded terrain is suggested for investigating the mean UHF-VHF field strength during the communication between a low-lying point and central station whose antenna is placed above the tree-line. The forest vegetation is divided into three categories for this purpose: tree trunks, large branches, and small branches. Each category is simulated by a separate model. The intensity contribution of each forest element is calculated in a first approximation of the multiple scattering theory and the problem geometry is plotted. The mathematical model is used as the basis of a routine written in the Fortran language and executed on an interactive computer complex (DVK) type microcomputer. The dependence of the

mean field attenuation in the forest on such model parameters as frequency, distances, antenna elevation, and other electrophysical and morphological variables is examined using the routine. A numerical analysis of the forest medium shows that trunks and large branches make the principal contribution to the scattered field since their dimensions are commensurate with the wavelength. Figures 1; references 2.

### Physical and Technological Aspects of Producing MIM-Cathode Arrays for Plane Screen of Vacuum Luminescent Display Tube

927K0364H Moscow *RADIOTEKHNIKA I ELEKTRONIKA in Russian* Vol 37 No 4, Apr 92  
(manuscript received 12 May 91) pp 713-720

[Article by G.A. Vorobyev, V.M. Gaponenko, S.A. Gyn-gazov, S.S. Kramor, R.B. Lubsanov, and P.Ye. Troyan; UDC 621.382.02]

[Abstract] Problems of producing MIM-cathode arrays for plane screens of display tubes are reviewed and analyzed from the standpoint of engineering physics. We considered arrays which consist of two parallel tiers of metal strip electrodes oriented orthogonally to one another, with an active dielectric film on a protective dielectric ( $\text{SiO}_2$ ) layer separating the upper tier from the lower one. The favorable physical characteristics of such arrays are: 1) low control voltage, which allows miniaturization and circuit integration; 2) high mechanical strength and vibration resistance; 3) high resistance to radiation; 4) long life in the pulse mode of operation; 5) ability to operate under technical vacuum of 1 mPa; 6) smooth emission current-voltage characteristic, which facilitates amplitude modulation of light signals with fine luminance gradation. The unfavorable characteristic is a small current transfer ratio, this being one of the problems still to be solved. The three major technological problems are increasing the emission current density, ensuring a more uniform emission distribution among the cathodes, and optimizing the formation of MIM-cathodes for prevention of excessive heating. As a guide for solving these problems, it is possible to use experimental curves indicating: 1) how the number of emission centers and the number of breakdown channels depend on the array formation voltage and the thickness of the active dielectric film; 2) how the number of emission centers depends on the thickness of the active dielectric film and on the microrelief of the lower electrode tier, different microreliefs having been produced by treatment with diamond pastes of three different size fractions (1  $\mu\text{m}$ , 3  $\mu\text{m}$ , 10  $\mu\text{m}$ ). It is recommended that MIN-cathodes be formed by parallel application of voltage pulses along entire rows or along a few rows at a time. As a guide, it is possible to use experimental curves indicating how the MIM-cathode formation rate depends on the duration of applied voltage pulses at various temperatures (20°, 100°) and on the repetition rate of applied constant-duration pulses. Figures 7; references 8.

**Monolithic Balanced Mixer for Short Millimetric Waves**

927K0364I Moscow *RADIOTEKHNIKA I ELEKTRONIKA in Russian* Vol 37 No 4, Apr 92 (manuscript received 28 Dec 90) pp 736-743

[Article by V.G. Bozhkov, V.F. Vdovin, V.N. Voronov, V.A. Genneberg, Yu.A. Dryagin, I.V. Kuznetsov, L.M. Kukin, K.I. Kurkan, and L.I. Fedoseyev; UDC 621.382.2]

[Abstract] A monolithic GaAs integrated-circuit balanced mixer has been built for millimetric-wave receivers operating without diplexer. It includes a pair of Schottky-barrier diodes connected in series, a slotted-waveguide segment matching the diode pair to the input signal, segments of a strip line and of a coplanar line decoupling the signal circuit from the heterodyne oscillator, a finned probe with a heterodyne channel, a mixing circuit, and an intermediate-frequency circuit with a filter. The diodes were produced by deposition of a 3-5  $\mu\text{m}$  thick strongly doped  $n^+$  layer and a 0.1-0.15  $\mu\text{m}$  thick active  $n$ -layer with an  $(8-10) \times 10^{16} \text{ cm}^{-3}$  carrier concentration on a semi-insulator substrate, the Schottky barrier being produced by metalization with a Ti-Au coating and the ohmic contact by deposition of gold and an Au-Ge alloy. The mixer chip is 1.42 x 2.85  $\text{mm}^2$  large and placed in the longitudinal slot (E-plane) of a waveguide. For testing, this mixer was mounted inside a 10 mm thick waveguide flange between two rectangular waveguides 0.8 x 1.6  $\text{mm}^2$  in cross-section: one for signals from the receiver antenna and one for signals from the heterodyne oscillator. The respective signals thus entered the mixer from opposite sides, the i-f signals then leaving it through two coaxial cables. The mixer was tested for performance in a double-sideband receiver not only over the nominal 130-170 GHz frequency range but also at frequencies up to 370 GHz, producing high intermediate frequencies having been made possible by use of Schottky-barrier diodes (upper cutoff frequency 1,800 GHz, maximum parasitic capacitance 0.01 pF, nonideality of current-voltage characteristics 20 %). The heterodyne oscillator for this test consisted of two backward-wave tubes covering the 130-370 GHz frequency range, its output signals passing through a Mach-Zehnder interferometer for rejection of amplitudinal signals and then through an attenuator to the mixer. The tests covered the entire 130-370 GHz frequency range at room temperature, 137 GHz and 167 GHz tests having also been performed at 40 K and 77 K temperatures. The tests yielded the frequency dependence of the receiver two-band noise temperature and its dependence on the mixer current, the frequency dependence of conversion losses and of the mixer noise temperature. They also revealed generally much lower noise temperatures and somewhat higher conversion losses at cryogenic temperatures. Figures 3; tables 4; references 11.

**Stabilization of Microwave Signal Power Level in Amplifiers Limiters**

927K0364G Moscow *RADIOTEKHNIKA I ELEKTRONIKA in Russian* Vol 37 No 4, Apr 92 (manuscript received 21 May 90) pp 699-705

[Article by A.V. Baranov and S.L. Morugin; UDC 621.375.029.64]

[Abstract] An engineering method of designing microwave amplifier limiters is proposed which will ensure a stable output power level during destabilizing wide variations of ambient temperature and input power. Following an analysis of amplifier behavior in the under-voltage mode with current cutoff and the effects of both destabilizing factors, the optimum control mode is determined in the approximation of negligible harmonic content in the output current and a piecewise-linear transfer characteristic of the device. The method is demonstrated on noninductive two-transistor microwave devices. The circuit of an amplifier-limiter featuring highly efficient output power limitation consists of a KT 657 A-2 npn transistor in common-emitter connection, a KT 370 A-2 pnp transistor with base tied to collector into a diode configuration, three resistors (R-1 between the two transistors, R-2 between KT 657 A-2 collector and positive voltage supply terminal, R-3 between KT 370 A-2 emitter and positive voltage supply terminal) for setting the mode of operation, two strip line segments and two capacitors for input-to-output impedance matching, two strip line segments and two capacitors for decoupling the microwave circuit from the voltage supply. The circuit of an amplifier-limiter featuring high thermal stability of the output power level is essentially the same, with the resistance R-1 selected so as to ensure that an increase of gain caused by a temperature fall will be optimally compensated by the decrease of gain caused by shift to an operating point with a smaller d.c. component on the output side. Figures 4; references 10.

**Spatial Chaos in Discrete Model of Radio Engineering Medium**

927K0364F Moscow *RADIOTEKHNIKA I ELEKTRONIKA in Russian* Vol 37 No 4, Apr 92 (manuscript received 31 Oct 90) pp 651-660

[Article by V.I. Nekorkin; UDC 621.373.1]

[Abstract] A discrete chain model of a one-dimensional radio engineering "trigger" medium with diffusionally coupled elements  $u_j(n+1) = u_j(n) + d[u_{j+1}(n) - 2u_j(n) + u_{j-1}(n)] + \alpha f(u_j(n))$  is considered where  $j$  is the discrete space coordinate,  $n > 0$  denotes discrete time,  $u_j(n)$  is a variable which characterizes the medium,  $\alpha > 0$  is a parameter which characterizes the medium,  $d$  is the "diffusion" coefficient, and  $f(u) = u(u-a)(1-u)$  ( $0 < a < 1$ ). This model is the discrete analog of an equation of the Kolmogorov-Petrovskiy-Piskunov kind. It is treated as a dynamical one with a phase space  $B = [u = (\dots, u_{-1}, u_0,$

$u_1, \dots, u_j, \dots$ ) and a norm in which "decay" of perturbations from the vicinity of the static state means that they tend to approach zero within any finite part of space, their "buildup" at "infinity" being not faster than exponential. This model has three spatially uniform static states corresponding to three fixed points. In the phase plane  $(x, y)$  defined by the diffeomorphism  $T = (x, y) \rightarrow (y, 2y - \alpha(f(y)/d - x))$  there exists, for certain values of the parameters, a region in which the  $T$  transformation operates as does "Smale's horseshoe" transformation. A stability analysis of its static states reveals that this model has a continual set of stable static states, stable in the linear approximation and at least when parameter  $\alpha$  is small in the exact nonlinear representation. The number of static states is infinite, available for a multistable system, the initial conditions determining in which static state the system will find itself. Spatial chaos is achieved in this model, because there exists a trajectory which corresponds to any bilaterally infinite sequence of symbols in Bernoulli's topological scheme so that any arbitrarily intricate profiles of static states are possible. The author thanks V.S. Afraimovich for helpful discussions. Figures 5; references 20.

#### Computer Simulation of Scattering of Electromagnetic Waves by Randomly Uneven Surfaces

927K0364E Moscow *RADIOTEKHNIKA I ELEKTRONIKA in Russian* Vol 37 No 4, Apr 92 (manuscript received 6 May 91) pp 628-633

[Article by G.A. Andreyev, T.V. Galkina, T.I. Orlova, and Ya.L. Khlyavich; UDC 621.371.029.65]

[Abstract] Scattering of electromagnetic waves by randomly uneven surfaces is considered and simulation of their scattering on a computer by the Monte Carlo method is proposed for plotting of the indicatrix, with the probabilistic model of scattering and the known tangent plane method extended from the two-dimensional cylindrical approximation of natural surfaces to three-dimensional scattering surfaces more accurately describing real natural surfaces. The simulation procedure consists of eight steps: 1) selection of point for incidence of rays on scattering surface; 2) selection of glancing angle for incident rays; 3) inspection for possibility of vignetting; 4) description of the local tangent surface; 5) examination of rays for the possibility of their being absorbed at point of incidence; 6) preliminary calculation of trajectories of reflected rays; 7) inspection for possibility of rereflection; 8) final determination of trajectories. The procedure is demonstrated on a surface and on a local tangent plane which happens to be the secant plane passing through three points on the surface forming a right triangle: one in a given node of the grid at the upper vertex of this triangle and the other neighboring two at the two nodes joined by the base of this triangle. The numbers of horizontally polarized reflected rays and of vertically polarized reflected rays are calculated according to appropriate formulas applicable to the Fresnel region, whereupon is calculated the intensity of horizontally polarized radiation entering the receiver

antenna after reflection by the local tangent plane. Scattering indices plotted by this method for 30° and 50° grazing angle are very close to the theoretically calculated ones, but not those plotted for a 5° grazing angle. The method can be extended to small grazing angles, if intensity redistribution of scattered radiation is taken into account. Figures 5; references 5.

#### Estimating Parameters of Motion of Objects on Basis of High-Precision Angle Measurements

927K0364D Moscow *RADIOTEKHNIKA I ELEKTRONIKA in Russian* Vol 37 No 4, Apr 92 (manuscript received 25 Feb 91) pp 618-627

[Article by Yu.G. Bulychev, I.V. Burlay, and V.A. Motorkin; UDC 621.396.96]

[Abstract] A method of estimating curvilinear trajectories of moving targets on the basis of measurements made with a mobile direction finder is proposed, assuming that the errors of azimuth angle and elevation angle measurements are small and that their statistical characteristics are known. The method is based on a large class of kinematic models fitting the general description  $x_c, y_c, z_c = \sum a^{x,y,z} q_j(t)$  from  $j = 0$  to  $j = K$  ( $q_j$ —linearly independent functions), the location of the direction finder and the location of the target in a Cartesian system of XYZ coordinates being each described by a vector which varies in time. Individual and resultant estimates are formed here indirectly, assuming that it is possible to establish a functional likelihood corresponding to "actual angle + error" readings of a high-precision direction finder. The estimation algorithm includes nonlinear filtration. Estimation problems are analyzed for observability with a direction finder moving rectilinearly, which corresponds to  $K = 1$  and  $q_j(t) = t^j$  ( $t$ —time). It is demonstrated by a direct proof that the system of three resolvent equations for the parameters of the kinematic model is not solvable in the case of a uniform rectilinear direction finder motion and by an indirect proof that it is solvable in the case of a nonuniform one. The probability characteristics of this method are evaluated for the important practical case where the target viewing angles and the direction finder coordinates have been estimated with errors which at each instant of time were normally distributed random quantities, all having zero expectations and each having its particular dispersion. References 13.

#### Interpretation of Sun Probing Radar Experiments

927K0364C Moscow *RADIOTEKHNIKA I ELEKTRONIKA in Russian* Vol 37 No 4, Apr 92 (manuscript received 22 Feb 91) pp 612-618

[Article by I.V. Chashey and V.I. Shishov; UDC 621.396.01]

[Abstract] The readings of a 38 MHz (8 m) radar used in sun probing experiments for information about the sun's upper atmosphere (J.C. James; *ASTROPHYSICS*, Vol 146 No 2, 1966) are interpreted on the premise that the

mechanism of echo signal formation is multiple spatial scattering of incident signals by large-scale inhomogeneities with characteristic dimensions of the order of 1 km in the solar corona. This hypothesis is based on consideration of turbulence in the solar corona and supercorona, turbulence caused by MHD waves entering from the intermediate layer. As the physical model, transfer of monochromatic radiation through a randomly refracting medium is considered. The corresponding vector differential equation of radiation transfer through a stationary refracting medium is accordingly formulated on the assumption of a near unity relative dielectric permittivity of the solar plasma and negligible refraction of radiation by the mean permittivity gradient, thus on the assumption that scattering of a signal takes place within corona regions sufficiently far from the zero permittivity level. For a nonstationary medium the radiant flux density is replaced with the coherence time function (mean product of coupled fields with time shift), the equation now including a coefficient which characterizes the combined effect of regular and wave movements. This equation is solved in the three-ray approximation (incident ray at  $30^\circ$ ,  $90^\circ$ , reflected ray at  $150^\circ$ ), with the derivatives in the corresponding system of three coupled scalar differential equations replaced with finite difference. Four key characteristics of an echo pulse signal returning from the solar corona are evaluated on this basis, namely: 1) brightness distribution over the visible disk, which by application of Lambert's law yields the radius of the effective radius and the scattering cross-section of the reflecting sphere; 2) waveform; 3) spectrum; 4) Doppler shift of carrier frequency. The results of radar experiments reported by J.C. James are shown to fit these authors' corona turbulence model (ASTRONOMICHESKIY ZHURNAL, Vol 60 No 3, 1983; Vol 61 No 3, 1984) and hypothesis of spatial backscattering. References 10.

#### Reconstructing Amplitude-Phase Distribution of Radiating Currents in Antenna Systems With Aid of Green's Conjugate Operator

927K0364B Moscow *RADIOTEKHNIKA I ELEKTRONIKA* in Russian Vol 37 No 4, Apr 92 (manuscript received 11 Feb 91) pp 592-604

[Article by N.S. Absalyamov and V.N. Garmash; UDC 621.396.677.49: 621.391.2]

[Abstract] The problem of reconstructing the amplitude-phase distribution of radiating currents in an antenna system aperture on the basis of phase and complex-amplitude measurements made in the Fresnel region is solved with the aid of Green's conjugate operator. For this the electric field at a point on an arbitrary surface outside the antenna is expressed in a compact vector-matrix form containing Green's matrix (tensor) function and thus implicitly Green's scalar function. This method is then tested for accuracy and resolution, considering that the dispersion of the reconstruction error is proportional to the dispersion of the random measurement error. The mean square deviations of amplitude readings and phase readings are calculated on the basis of a statistical model

which describes: 1) the dependence of the mean square deviation of current amplitude calculation on the random error of field amplitude measurement and on the magnitude of the field phase measurement error, 2) the dependence of the random error of current phase calculation on the mean square deviation of field phase measurement and on the magnitude of the field amplitude measurement error. The results indicate that both mean square deviations of current amplitude and phase in the reconstructed distribution can be simultaneously minimized. The resolution of this method is evaluated for two problems which do have analytical solutions: 1) cylindrical geometry of field measurement within a sector of a circular cylinder around an electric current filament as test source, 2) planar geometry of field measurement on an infinite plane with a point dipole as source. The results of these tests indicate that this method is suitable for antennas with either discrete or continuous distribution of radiating currents, including phased wide-aperture antenna arrays. Figures 5; references 11.

#### Radiation Emission by Plasma-Covered Prolate Spheroidal Antenna

927K0364A Moscow *RADIOTEKHNIKA I ELEKTRONIKA* in Russian Vol 37 No 4, Apr 92 (manuscript received 19 Nov 90) pp 583-592

[Article by N.M. Roslyakov and N.A. Tenyakova; UDC 621.396.67]

[Abstract] Radiation emission by a linear dipole antenna surrounded by a layer of a cold plasma is analyzed theoretically, a prolate ellipsoidal dipole being considered on account of its practical importance. It consists of two semiellipsoids of revolution separated by a narrow clearance for the feeders and covered by a confocal spheroidal plasma layer. Its radiation emission characteristics are calculated by the method of eigenfunctions, Maxwell's equation for the electromagnetic field components being solved for emission of transverse magnetic waves under appropriate boundary conditions. The requirement of finiteness at both vertex points  $\eta = +1, -1$  on the major axis limits the range of admissible functions to first-order prolate angular spheroidal functions, inasmuch as the second-order functions have singularities at these points. Inclusion of those of third and fourth orders ensures a solution for the plasma region which accounts not only for waves emitted by the antenna but also waves reflected back into the plasma layer by its outer boundary. A numerical analysis performed on a Standard System 1035 computer in the Fortran language has yielded the frequency dependence of the antenna input resistance and reactance, radiation resistance, and efficiency, also of the radiation power in the Fraunhofer region. The effect of a surrounding plasma layer is readily evaluated by having all these parameters as ratios of their values in the presence of such a layer to their values in the absence of one. Their frequency characteristics have been plotted in the form of universal curves: against the inverse of the operating frequency to resonance frequency ratio. Figures 6; references 8.

**Effective Devices for Reducing the Noise Level in Communication Equipment**

937K0035D Moscow AVTOMATIKA,  
TELEMEKHANIKA I SVYAZ in Russian  
No 9, Sep 92 pp 28-30

[Article by Ye. Ye. Golikov]

[Abstract] To protect the railroad communication equipment from interferences, devices which filter the interfering voltages, or compensate them by the opposite phase voltages, are used. The low frequency filters are bulky and expensive. Compensation of the noise using separate amplifiers and complex phase shifters is also expensive. This study describes a less expensive and technologically simpler approach of combining the function of amplifying the useful signals and the compensating suppression of interferences in the input amplifier of the communication equipment. Most simply this problem can be solved by application of an operational amplifier. A diagram is provided of a device for suppressing the low frequency interfering voltages induced by the contact network of the ac train drive, which also performs the input amplifier functions, and its operation is described. In order to reduce the dependence of the results of the interference suppression on changes in the attenuation and phase shift of the filter in the passband, the device lowers the slope of the attenuation build-up and the filter phase shift with increased frequency. This and other measures which are directed at expanding the spectrum of suppressed interferences, also provide an effective suppression of interferences with frequencies above 50 Hz. Figures 3.

**The Quality of Voice Frequency Channels in Communication Systems With Pulse Code Modulation**

937K0035C Moscow AVTOMATIKA,  
TELEMEKHANIKA I SVYAZ in Russian  
No 9, Sep 92 pp 25-27

[Article by V. V. Shmytinskiy, V. P. Glushko]

[Abstract] High noise immunity, and channel quality, adaptability to streamlined manufacturing and servicing as well as a low cost constitute the principal advantages of digital transmission systems (DTS). The digital linear channel, and transmission of binary symbols, provides a high noise immunity, and the use of logic integrated circuits is responsible for easy manufacturing. The factors are examined here, which contribute to the channel quality of the DTS, and the composition of the DTS is analyzed. At the present time the industry manufactures and the railroad communication network employs primary and secondary transmission systems IKM-30 and IKM-120. Higher order systems, the IKM-480 and IKM-1920, are also available.

**Operational and Engineering Requirements to the Signalling, Centralization and Blocking Relay**

937K0035B Moscow AVTOMATIKA,  
TELEMEKHANIKA I SVYAZ in Russian  
No 9, Sep 92 pp 19-20

[Article by M. S. Podgaychenko, R. Sh. Yagudin]

[Abstract] Operating and engineering specifications for signalization, centralization and blocking relays are described. The specifications were developed and approved by the signalization, communication and computer technology administration of the Railroad Ministry. It is pointed out that during the last 2 years many cases of the ANSh5 and PL model relay malfunctions on the railroads were recorded. The analysis of these cases indicate that these relays exhibited construction defects. The technological process was violated during their manufacturing, and some specifications were not followed. Strong measures must be taken to assure a high quality manufacturing of safe railroad relays and to enforce the adherence to the technical specifications. A coordinating council was established to promote modernization, improvements of design, an to assure a greater safety of the relays, and a working group on relays was organized at the "Giprotranssnal'svyaz" institute. Representatives of the "Soyuzzheldoravtomatizatsiya" and the railroads conduct inspections of the equipment quality at the manufacturing plants.

**Dispatcher Control System DTsU-Ye: Providing Safe Train Traffic**

937K0035A Moscow AVTOMATIKA,  
TELEMEKHANIKA I SVYAZ in Russian  
No 9, Sep 92 pp 17-18

[Article by D. V. Shalyagin; UDC 656.22.05:656.256.05]

[Abstract] The dispatcher control of train traffic is provided by a dispatcher centralization system (DC), electric centralization (EC) at stations and automatic blocking (AB), while the EC and the AB systems are responsible for the train traffic safety. Methods and equipment which are used for providing safety with the DTsU-Ye system are discussed. This system can be arbitrarily divided into three subsystems. The devices of the Central post (CP), or the command station, are much more complex than the AB or EC devices. Here, the safety functions constitute a relatively small portion of the total functions of the entire complex. Therefore, it is not efficient to carry out the safety measures by conventional methods using instrumental redundancy, and special CP devices were developed with parameters which would assure safe train traffic without the need of a computer aided instrumental redundancy of their functioning. For the information transmission subsystem, the principal method of providing safety relies on the information redundancy of the code combinations of the engineering and service commands. In the devices used at the linear stations of the TDsU-Ye system, the safety measures are provided by instrumental redundancy,

which consists of doubling the functional modules, while their performance is monitored by a special element for equipment control.

### Dispatcher Control System DTsU-Ye

937K0015A Moscow AVTOMATIKA,  
TELEMEKHANIKA I SVYAZ in Russian  
No 8, Aug 92 pp 4-8

[Article by V. M. Lisenkov, D. V. Shalyagin, V. F. Matveyev; UDC 656.256.05]

[Abstract] The dispatcher control (DC) systems, which are now on the railroad networks of the Commonwealth countries, were developed in the 1960-70s. They are outdated and can not satisfy all requirements to the DC systems. A dispatcher centralization and control system DTsU-Ye which employs contemporary computer technology and specialized software was developed by the specialists of the Moscow Institute of Railroad Engineers and the joint venture "Dialog". After submitting the engineering specifications in April 1990, the development of the system was completed in 1991. Central Post devices of the DTsU-Ye system, which incorporate two IBM PC/AT 286 computers were installed at the dispatcher centralization and control stations of the Byelorussian railroad, and are operational at the Molodechno-Polotsk section, which is 200 km long. This system combines in a single structure the functions of processing and generating the information signals, with functions of the expert system operating in real time mode with a data base obtained by remote control channels. The DTsU-Ye system performs a continuous control of the train traffic over the section in an automatic mode, forecasts possible deviations from the schedule of the train traffic, issues recommendations to the dispatchers on the necessary measures for preventing these deviations, controls train speed, etc. Figures 5.

### Microprocessor System for Coded Control

937K0035F Moscow AVTOMATIKA,  
TELEMEKHANIKA I SVYAZ in Russian  
No 9, Sep 92 pp 34-36

[Article by V. L. Angelevich, A. V. Truntayev; UDC 681.325.5-181.4:656.2]

[Abstract] A Microprocessor system for a coded control (MSCC) of devices at a small size railroad (executing) station or a junction from the command station is described, and a structural diagram of the operation is provided. The operator at the command station controls two stations and monitors their traffic. A BK-Orel type microcomputer system board is used at the command station for generating the controlling codes and for decoding. The conditions of the executing station devices, the activity of the attendant at the command station and other information are displayed on the screen. The executing station can be equipped with the electrical centralization devices of most any system. The

devices of both stations are connected by a four-wire communication line. Examples are supplied of the system functioning. Figures 3.

### Application of the IKM-120 Transmission System on Functioning Railroad Cable Main Lines (Part 1)

937K0015B Moscow AVTOMATIKA,  
TELEMEKHANIKA I SVYAZ in Russian  
No 8, Aug 92 pp 22-24

[Article by V. Ye. Vinokurov, V. V. Vinogradov, V. K. Kotov]

[Abstract] Transmission capacity of the operating two-cable main-lines can be significantly increased by employing the IKM-120 (pulse code modulation) system. In order to assure the effective functioning of this system, the linear circuit of the IKM-120 must be protected from pulsed interferences. There are interferences which "accompany" the transmission signals, and the external interferences (thermal noise). The cumulative effect of these interferences, in addition to causing instability of the signal amplitude, phase jitter, etc., reduce the performance of the DTS. The specific sources of pulsed interferences in the railroad communication cables include the linear automatic blocking circuits, the communication circuits between stations, subscriber lines, electric centralization devices, train radio communication, etc. The linear signalization, centralization and blocking circuits, and pulsed relays of the rail circuits produce the most significant impact on the IKM-120 linear circuit. This article describes the results of the study dealing with the external interferences generated in the linear channels of digital transmission systems (DTS), and recommendations for their reduction are made.

### Automatic Regulation of Rail Code Circuits

937K0015C Moscow AVTOMATIKA,  
TELEMEKHANIKA I SVYAZ in Russian  
No 8, Aug 92 pp 24-27

[Article by V. I. Kalabin, V. V. Kozlov, V. N. Panov; UDC 656.256:621.391.31]

[Abstract] Because of continuous contamination of the railroad surface with various loose materials from the freight, a significant section of the rail circuits of the railroad network is operating with a reduced resistance of the insulation. An effective method for assuring functioning of the rail code circuits would be the installation of several shortened low frequency rail circuits within the unit section. However, because of limited resources and manpower, the problem of reduced resistance of the insulation can not be fully resolved, and sections of the code rail circuits are operating with seasonal adjustments. Engineering solutions are proposed directed at automation of the seasonal regulation of the rail code circuits with the aim of reducing possible

delays in the train traffic and increasing the safety with minimal outlays. A "Monitoring-preserving" concept of the rail circuits automatic regulation is discussed.

### **Designing the Parameters of Grouped Telephone Circuits for Operating and Engineering Communication**

937K0015D Moscow AVTOMATIKA,  
TELEMEKHANIKA I SVYAZ in Russian  
No 8, Aug 92 pp 27-30

[Article by Yu. P. Chebotarev; UDC 656.259:621.3.025]

[Abstract] At the present time physical cable circuits and aerial communication lines are normally used on railroads for organization of grouped telephone circuits for operation and engineering communications. Only recently, because of availability of the K24T equipment, it became possible to organize group communication using the voice frequency channels. The particular features of constructing group circuits frequently cause difficulties in providing a required quality of voice transmission and reliable functioning of the selective call system. The group circuits are nonuniform. Their parameters can significantly vary from the uniform circuits, therefore, for proper organization of group communication these parameters must be determined and estimated. A simple method was developed for computing the wave parameters of the group circuits and the effects of various factors on these parameters were examined. The main feature of the group circuit lies in multiple parallel connections of various devices for conversations, reception and calls. Each of these devices has some impedance, and depending on its value, a shunting effect of the devices on the telephone circuit is produced. The electrical characteristics of the group telephone circuit can be controlled by varying the value of the input impedances of the devices at the intermediate points. Figures 9.

### **Centralization at High-Speed Railroad Sections in the FRG Using Microprocessor Technology**

937K0015E Moscow AVTOMATIKA,  
TELEMEKHANIKA I SVYAZ in Russian  
No 8, Aug 92 pp 38-39

[Article by M. I. Smirnov]

[Abstract] Microprocessor technology including microprocessor centralization (MC) of the controlling signals and switches is extensively employed at high-speed sections of the state railroads in the FRG. Several railroad stations are equipped with the Siemens Els model MC, where the earlier used models, which employed separate zonal and executing microcomputers based on the microprocessor system SIMIS B, are replaced by combined zonal and executing microcomputers based on the SIMIS C failure-safe system. The software of the combined microcomputer provides for a possible interaction both with the instruments of the command station and

the devices controlling the signals, switches and the rail circuits. Composition and performance of the MC is described and a structural diagram of a typical system is provided. Figure 1.

### **New Generation of Telegraph Channel Forming Equipment**

937K0035E Moscow AVTOMATIKA,  
TELEMEKHANIKA I SVYAZ in Russian  
No 9, Sep 92 pp 33-34

[Article by N. F. Semenyuta; UDC 656.254.141]

[Abstract] Low service quality of the telephone calls occurring in the process of upgrading the automatic switching telegraph communications (ASTC) network constitutes one of the problems at some sections of the main telegraph lines, particularly in the East, Middle East and Transcaucasian regions. This situation is primarily caused by a low transmitting capacity of the telegraph channels. The number of telegraph channels can be increased by employing a new generation equipment and by optimizing the structure of the ASTC network, and load concentration at the telegraph switching points. Composition of the component units and functioning of a time sharing equipment TVR "Tantal" is described. The time share equipment incorporates a telegraph multiplexer and a demultiplexer with a 2.4 kbit/sec modem; a statistic demultiplexer with a 2.4 kbit/sec modem; a device for converting signal to the transmission rate of 9.6 kbit/sec; a control panel and an voltage converter. This equipment belongs to the new high efficiency telegraph communication technology. From 2 to 5 times more telegraph channels can be organized with this equipment than with frequency demultiplexing. Structural diagrams of the communication organization within a railroad station and between railroad points are provided. Figures 2.

### **Passenger's Information System**

937K0035G Moscow AVTOMATIKA,  
TELEMEKHANIKA I SVYAZ in Russian  
No 9, Sep 92 pp 36-38

[Article by Z. Ye. Lomovitskaya]

[Abstract] Systems for providing information, or communication services to the express train passengers of several foreign countries are described. On such trains, in addition to the fundamental facilities, train radio and telephone etc., the passengers enjoy special communications services for greater travel comfort. Thus, a satellite antenna is installed in the Super Hitachi express trains in Japan, and personal color TV are mounted at each of the 33 seats. In addition to providing information to the passengers, the system performs train control and other engineering services. The railroad information system for passengers in Germany, designed by MAN Technologie AG, has a three-level hierarchic modular structure with a microprocessor control. It interconnects the train

and car control points with terminal devices. These devices include controllable indicators, information display terminals, loudspeakers, headphones for listening to the music programs, or broadcast, video devices, telephones etc. In the TGV-A train line of the French

railroads, a system is used which combines the control, diagnostic, and engineering services with passenger information. The system employs the intertrain communication and train radio networks for providing various communication services.

### Basic Statistical Models of Radar Intelligence Collecting Process in the Presence of Radar Countermeasures

937K0009C Moscow *RADIOTEKHNIKA* in Russian  
No 1-2, Jan-Feb 92 pp 24-31

[Article by V. G. Radziyevskiy, A. A. Sirota; UDC 621.396]

[Abstract] The principal objective of electronic intelligence gathering under conflict conditions between radar and the countermeasures, is a reliable and efficient extraction of information on the presence and state of the radar countermeasures by analysis of the radio signals. A multilevel system is described of hierarchic dynamic models of states (DMS) and monitoring of the countermeasures objects, in the process of collecting the electronic intelligence. This system makes it possible to synthesize the general algorithm for information processing. Communication between different levels of the DMS is carried out by transmitting "from top to bottom" a priori information, which specifies the initial conditions and structure of the lower level DMS. Communication between the monitoring models is conducted "from top to bottom" by transmitting a priori information, reflecting the results of the decisions, made at the lower levels in the course of processing. In order to perform the information synthesis and analysis with this system, the probability characteristics must be specified, which describe the quality of the decisions made at each level. With a fixed criteria of the decision making, they can be obtained, if the corresponding background noise is described for each monitoring model. Figures 2, references 5 Russian.

### Estimates of a Winning Situation With Radar Conflict

937K0009D Moscow *RADIOTEKHNIKA* in Russian  
No 1-2, Jan-Feb 92 pp 32-35

[Article by V. M. Shlyakhin, V. L. Karokotskiy; UDC 621.396.96]

[Abstract] Target search and detection facilities (radar - side A) and the object of detection, which includes the target and the countermeasure devices (side B) constitute the principal opposing sides under conditions of electronic warfare (radar conflict). The general strategy of side A consists in trying to surpass the opposing side B, and in maximizing the probability of search and detection under conditions of space-time limitations. The objective of side B is to eliminate or to complicate the practical implementation of side A strategy under these conditions. Distribution principles (for a fixed time) for the radar side or the opposing countermeasures side winning are determined by applying the search theory, the radar target location methods and the markov random processes. Here, the winning is defined as a state of achieving the desired objectives. In order to create the most favorable conditions for winning under conflicting radar detection, the main characteristics and algorithms

of each side's functioning must be selected not just by tactical and technical considerations, but by taking into account the response of the opposing side. The side which can predict with a better probability the possible moves of the opponent has a better chance for success. Figure 1, references 5: 4 Russian, 1 Western.

### Capacities of Contemporary Radar With Joint Application of "Stealth" Type Methods and Active Noise Jamming

937K0009B Moscow *RADIOTEKHNIKA* in Russian  
No 1-2, Jan-Feb 92 pp 12-18

[Article by V. V. Bykov; UDC 621.396]

[Abstract] In the absence of active jamming, radar range is theoretically limited by the effective scattering area of the detected object and by the level of natural noise, which includes the intrinsic noise and reflections from the underlying surface. Relationships are obtained for the range of six principal types of contemporary radars as a function of the effective scattering area (ESA), which is decreased with application of "Stealth" type technology, with or without active noise interference. The relationships take into account the intrinsic noise and reflection from the underlying surface. Levels are determined when the reduced effective scattering area renders the radar inoperative. The results of computations of the required ESA reduction level of objects, assuring their low radar visibility, indicate that in most cases this level must be 30...40 dB. This level of ESA cannot be achieved at the present time. A combined application of the ESA reduction methods and active jamming is discussed. Tables 2, references 4: 3 Russian, 1 Western.

### Optimization of Optical Range Finder Beam-Width When Measuring Slant Range to the Earth Surface

937K0009E Moscow *RADIOTEKHNIKA* in Russian  
No 1-2, Jan-Feb 92 pp 53-56

[Article by F. I. Khaytun, S. A. Rasskazov, R. B. Shemshedinov; UDC 621.384.326.28]

[Abstract] We examined the effects of the pulsed optical range finder beam-width on the conditions of signal detection when measuring slant range to the Earth surface at small sighting angles with respect to the horizon. The non-stationary character of the surface illumination is a factor responsible for stretching of the reflected signal, making it advisable to narrow the beam-width to a limit which corresponds to a quasi-stationary illumination of the surface; speckle fluctuations, and the time lag of the photo detector are factors calling for a wider beam. Computations indicate that for the examined case there is an optimal width of the illuminating field  $Q = Q_{opt} = 0.3 - 0.4$  min. The beam-width narrowing from  $Q = Q_0 = 2$  min (which is typical value for many existing optical pulsed range finders) to  $Q = Q_{opt}$ , produces a relative energy gain by a factor of 1.9 for an avalanche

photo-diode (APD), and by a factor of 1.3 for a photo-diode (PD). With the APD, the photo detector time-lag does not appreciably change the value of  $Q_{opt}$ , but for the PD the time lag is significant. When operating in a spectral region  $\lambda = 10.6$  micrometers, detectors are now employed without internal multiplication of the photo current, and with small internal resistance. Figures 2, references 6 Russian.

### Concepts for Modeling the Opposing Sides Interaction Dynamics Under Conditions of Electronic Warfare

937K0009A Moscow *RADIOTEKHNIKA* in Russian  
No 1-2, Jan-Feb 92 pp 4-11

[Article by Yu. S. Sukhorukov, V. M. Shlyakhin; UDC 621.396.96]

[Abstract] The search theory, radar target detection and the theory of random markov processes are applied for developing the methods for estimating the probability of resolving an electronic conflict in favor of either the radar or the countermeasures, depending on their fundamental characteristics and duration of the conflict. Three possible types of electronic warfare are envisioned. The simple conflict is defined as an interaction of the countermeasures (side B) with radar (side A), which has an option of a passive evasion from the countermeasures. A two-sided conflict occurs in case of interaction of side B with side A and side  $A_1$ , which generates a counter-noise. The complex two-sided conflict takes place in case of the side B interaction with sides A,  $A_1$ , as well as with some third side  $A_2$ , whose function is to uncover the B and to disable it. The developed method for modeling the dynamics of the opposing sides interaction under conditions of the simple electronic conflict, based on representing the search efforts of one of the sides and countermeasures of the other side as random markov processes of multiplication and destruction, with consecutive conjugation of these processes into an equivalent flow of decision making, as well as the methods for analytic estimates of the probability characteristics of the sides can be extended to the other types of the electronic conflict. Figures 2, references 9: 8 Russian, 1 Western.

### Application of Random Search Methods for Design of Domes Which Are "Transparent" to the Radio Waves

937K0009F Moscow *RADIOTEKHNIKA* in Russian  
No 1-2, Jan-Feb 92 pp 80-83

[Article by V. A. Kaplun, V. M. Zelenkevich; UDC 621.396.67.001.24:621.391.007]

[Abstract] Optimal design of domes (fairings) which can pass radio waves requires solution of problems which are, in most cases multi-parametric and multi-extremal, with non-analytic relationships between the quality functions and the varied parameters. Methods of optimal search, using derivatives, are not effective for the solution of this kind of problems, and the random search method for scanning the efficiency function region must be applied. A double-criterion problem for a parametric synthesis of a dome wall, which can pass radio waves, was mathematically formulated. Several methods were examined, and the results of experimental and theoretical study of a synthesized seven-layered "transparent" wall are described. Algorithms were developed for optimal random search. The studies confirmed the efficiency of using the random search method for determining the conditional optimization parameters of stratified structures, which are "transparent" to radio waves. Figures 4, references 6: 5 Russian, 1 Western.

### Mathematical Model and Algorithm for Analysis of Electrodynamical Characteristics of Wire Radiators With Complex Configuration

937K0009G Moscow *RADIOTEKHNIKA* in Russian  
No 1-2, Jan-Feb 92 pp 87-89

[Article by O. B. Lishtayev, A. I. Luchaninov, S. V. Tolstova, V. M. Shokalo; UDC 621.396.67]

[Abstract] Wire radiators are widely used as independent antenna or as elements of different antenna systems. Because of strict requirements to the parameters and characteristics of the antenna, their configuration can be very complex. Simplified algorithms for design of these antenna do not produce good results. A universal algorithm is developed for effective analysis of the electrodynamic characteristics of the wire radiators with an arbitrary configuration. A set of rectilinear sections of thin cylindrical conductors, made of finite conductivity materials, located either in free space or above an infinite, perfectly conducting planar deflector, is used as a model of such radiators. The boundary problem is formulated as an integral equation. By applying the moment method, the initial integral equation can be reduced to a system of linear algebraic equations which can be expressed as a matrix. A non-standard matrix forming method is proposed for increasing the speed and rational utilization of computer memory. The advantages of employing a system of piece-sinusoidal functions are demonstrated. Standard procedure for determining the generalized impedance matrix with the piece-sinusoidal base consists in computing mutual impedances between currents, randomly oriented in space. The proposed algorithm is implemented as a set of applied programs. It is effective, universal and convenient for analysis of the wire radiators of arbitrary configuration. References 2 Russian.

**Two-Dimensional Inverse Problems of Wave Diffraction by Locally Heterogeneous Dielectric Scatterers**

937K0009H Moscow *RADIOTEKHNIKA in Russian*  
No 1-2, Jan-Feb 92 pp 90-94

[Article by A. P. Kusaykin, A. Ye. Poyedinchuk, Yu. K. Sirenko, V. P. Shestopalov; UDC 621.396.67]

[Abstract] Determination of electrodynamic characteristics of locally nonhomogeneous scatterers from a diffraction field belongs to one of the classical problems of electromagnetic wave diffraction. In the mathematical sense, this problem is reduced to the inverse problems of

Maxwell equations system. From the practical applications point of view, when dealing with this type of tasks, the stability and development of effective computation algorithms for their solution constitutes the principal problem. A method is proposed for examining two-dimensional inverse problems of reconstructing the electrodynamic characteristics of nonuniform dielectric scatterers from a known diffraction field. It was demonstrated that after satisfying particular conditions for the derived equation, there exists a classical solution, which in a general case, when conducting a numerical analysis of a particular problem, must be replaced by a normal solution in accordance with a selected regulation scheme of the improper operator equation. References 17: 9 Russian, 8 Western.

**Extent of Applicability of the Modified Method of Travelling Wave in Free Space**

937K0018A Moscow VESTNIK MOSKOVSKOGO  
UNIVERSITETA: FIZIKA, ASTRONOMIYA  
in Russian Vol 33, No 4, Jul-Aug 92 pp 8-13

[Article by; V. D. Gusev, S. M. Golynskiy; UDC  
538.573: 621.371.3]

[Abstract] We examined the limits of the applicability of a modified method of travelling waves for describing a wave field propagating in free space after passing a randomly nonhomogeneous medium. It is assumed that the scattering medium, such as the Earth ionosphere, can be replaced by a planar irregular screen. After passing this screen, the amplitude and phase of the wave undergo identical changes that would have occurred when propagating in a real medium. With approximation of a small angle scattering, a model is examined of normal phase fluctuations of the field scattered by the screen. A criterion is obtained of the method's applicability, which significantly extends the range of beam interpretation of the wave field in free space, compared to the standard methods of geometrical optics. One of possible applications of the results of this study deals with solution of inverse problems of reconstructing nonhomogeneous parameters of the examined medium from scattered radiation, received after passing free space. References 9 Russian.

**Cylindrical Ferroelectric Resonator With Plane-Parallel Electrodes at the Butt-Ends**

937K0018B Moscow VESTNIK MOSKOVSKOGO  
UNIVERSITETA: FIZIKA, ASTRONOMIYA  
in Russian Vol 33, No 4, Jul-Aug 92 pp 14-18

[Article by; G. V. Belokopytov, T. V. Krasnyuk; UDC  
537.8.029.6]

[Abstract] Cylindrical dielectric resonators (DR) are widely used for studies and radiophysical application of ferroelectrics with microwaves. If the butt-ends of the cylinder surface are equipped with electrodes, a dc bias can be applied to the DR, making it possible, by controlling the dielectric constant, to readjust the resonator. Assuming that the plane-parallel electrodes are infinite, analytical expressions can be obtained for the EM field components and equations derived for determination of the natural frequencies of anisotropic cylindrical DR. However, the obtained transcendental system is very complex and can not be effectively used for identification of the DR modes in the experiment. In this paper, the problem of determining the natural frequencies of a cylindrical dielectric resonator with a high dielectric constant is reduced to a solution of a single transcendental equation and a subsequent computation of corrections. References 9: 5 Russian, 4 Western.

**Transient Consistent Model of Field Emission From Metal Cathode**

937K0018C Moscow VESTNIK MOSKOVSKOGO  
UNIVERSITETA: FIZIKA, ASTRONOMIYA  
in Russian Vol 33, No 4, Jul-Aug 92 pp 18-21

[Article by B. A. Markov, A. D. Poyezd; UDC 517.958]

[Abstract] A model of autoelectronic emission for consistent nonlinear problems of high current microwave electronics is examined. By modeling a fully transient system of Maxwell-Vlasov equations it was demonstrated that the injection current exhibits a strongly manifested pulsed character with respect to time. The amplitude of the injection current attains a significant value even when the external field between the cathode and anode is absent. Thus, the amplitude of the electromagnetic field generated in the system is so high, that the electron injection becomes self-sustaining. Because the electromagnetic field generated in the system, within the framework of the model, is transient and high-frequency, the current of the injection beam exhibits identical properties. References 5 Russian.

**Relativistic Gyrotrons With the Beam Oscillatory Velocity Pumping in the Interaction Region by a Non-Adiabatic Magnetic Undulator**

937K0018D Moscow VESTNIK MOSKOVSKOGO  
UNIVERSITETA: FIZIKA, ASTRONOMIYA  
in Russian Vol 33, No 4, Jul-Aug 92 pp 22-28

[Article by; A. F. Aleksandrov, V. A. Kubarev, V. A. Cherepenin; UDC 621.385.6]

[Abstract] Weakly relativistic gyrotrons are the least explored instruments with a transverse interaction. Helical electron beams (HEB), which are employed with these gyrotrons, are normally formed with magnetron-injection guns, whose capacity, in terms of increasing the working voltage and beam current, is limited. In many cases when designing devices with a high output power, increasing the electron energy to relativistic values can be justified. Various design magnetic undulators are suitable for forming the HEB. A gyrotron design is proposed where the HEB forming region and the interaction region are combined. Magnetic undulators with lengthwise non-adiabatic field activation can be used for pumping. The limits of attainable efficiency of this type device are examined for various injector voltages. Modeling of the HEB formation in the non-adiabatic undulators with a leading magnetic field demonstrated, that in the resonant region of the magnetic fields, a steady state of the beam, which is typical for systems where adiabatic pumping is not established, and the electron motion is determined by the relationships which corresponds to a non-adiabatic activation. The results of the study indicate that the proposed method with the beam pumping using a non-adiabatic undulator in the region of interaction can be used for developing high power gyrotrons. Figures 4, references 8 Russian.

**Series-Parallel Connection of Pyroelectric Detectors of Pulsed Radiation**

937K0023A Moscow PRIBORY I TEKHNICA  
EKSPERIMENTA in Russian No 4,  
Jul-Aug 92 pp 75-77

[Article by B. A. Levin; UDC 539.227]

[Abstract] Thermoelastic oscillations can be generated in pyroelectric detectors by exposing them to a pulsed radiation, due to a rapid heating of the pyroelectric material by the absorbed radiation energy. The most effective method for suppressing these oscillations consists of selecting the detector's parameters, so that certain conditions are satisfied. For detectors made of ferroelectric ceramics, these conditions are difficult to satisfy. They can be largely removed by using a series-parallel connection of the pyroelectric detectors. An experimental test of the proposed method was performed with detectors made of ferroelectric ceramics PKD-124. The pyroelectric current in the detectors was generated by a 3 ms pulse of gamma neutron radiation. Measurements were made of the gamma value, generated on the unit surface of the series and parallel connected element. The measurements indicated that the shape of the current pulse is independent of the type of connection, and that the gamma value does not change. Figure 1, references 4 Russian.

**Instrument Transducer of Voltages Into Pulse Frequency**

937K0023B Moscow PRIBORY I TEKHNICA  
EKSPERIMENTA in Russian No 4,  
Jul-Aug 92 pp 95-97

[Article by A. M. Izmaylov, Azerbaydzhan Academy of Sciences Institute for Studying Natural Resources from space, Baku; UDC 621.317.725]

[Abstract] An instrument transducer of dc voltages into pulse frequency is described. With a direct voltage to frequency conversion, the necessity of increasing the upper frequency level of the output signal causes deterioration of the conversion accuracy. In the described transducer, this shortcoming is eliminated by using a controlled generator with a feedback circuit, and by equalizing the pulse duration, which is inversely proportional to the value of the input voltage, or current, with a period, which is multiple of the period of the controlled generator. The range of the input voltage is 0.1 - 5.0 V, and of the current is 0.1 - 5.0 mA. The range of the frequency changes is 5.0-250 kHz, the deviation from linearity with voltage conversion is smaller than  $\pm 5$  Hz, and with current conversion  $\pm 3$  V. The time of the output signal stabilization is 1.0 sec. Figures 1, references 2 Russian.

**Laser Device in the Picosecond Range for Studying Thermomagnetic Recordings**

937K0023C Moscow PRIBORY I TEKHNICA  
EKSPERIMENTA in Russian No 4,  
Jul-Aug 92 pp 141-146

[Article by S. N. Gadetskiy, M. V. Zyumkin, A. V. Stupnov, Ye. N. Nikolayev, Russian Academy of Sciences Institute of Energy Problems in Chemical Physics, Moscow; UDC 621.373.826]

[Abstract] Systems with optical memory provide a maximum information recording density. The most attractive systems are those with a reversible optical memory based on principles of a thermomagnetic recording and magneto-optic reproduction of information. Multilayer structures with amorphous metallic working layers, which are composed of rare-earth and transition metals, are used as information carrier. When the information recording speed reaches several megabits/sec, the duration of the laser pulse comprises several hundred nanoseconds. In order to investigate the interaction features of subnanosecond and picosecond laser pulses with amorphous magneto-optic metallic carriers, at this speed, a picosecond laser device was developed and is described here. Processes were studied with this device which occur in the working layer of the magneto-optic carrier under the impact of laser pulses with durations of 5 nsec, 500 and 20 psec, and energy of 1-10 mJ. With this device it was also possible to determine the value of the carrier sensitivity, during the thermomagnetic recording by picosecond pulses, as well as the threshold value of crystallization and melting of the magneto-optic amorphous carrier with picosecond heating. Figures 3, references 6: 1 Russian, 5 Western.

**Transducer of Changes in the Time Delay of Ultrasonic Signal in Solid State Bodies Into Amplitude**

937K0023D Moscow PRIBORY I TEKHNICA  
EKSPERIMENTA in Russian No 4,  
Jul-Aug 92 pp 192-194

[Article by O. V. Kropotin, Ye. N. Bulatov, V. I. Surikov, Omsk Polytechnical Institute; UDC 681.118.1: 620.179.16]

[Abstract] A transducer of the absolute change of the ultrasonic signal time delay into amplitude in a solid state sample is described. The measurement range of the transducer is 50 nsec, the sensitivity is 12 mV/ns, and the instrument resolution is 2 ns. Since no averaging of the results of several measurements is required, this transducer exhibits high speed. A block diagram, a circuit of the electrical components of the transducer, and time diagram of its performance are provided. When using this circuit, the real limitations of speed are due to the duration of the probing pulse, and properties of the controlled medium, and are not caused by the physical resolution. The range of the measured time delay can be expanded. Figures 2, references 2: 1 Russian, 1 Western.

**Preamplifier for High-Temperature Superconducting Quantum Interference Device**

937K0023E Moscow PRIBORY I TEKHNIKA  
EKSPERIMENTA in Russian No 4,  
Jul-Aug 92 pp 195-196

[Article by V. K. Ignatyev, Volgograd University; UDC 621.013.3+537.312.62]

[Abstract] Superconducting quantum-interference devices (SQUID) operating at temperature of liquid nitrogen had been developed with sensors built with superconducting ceramics. However, because of high noise, compared with the niobium sensors, operating at helium temperatures, the energy resolution of the radio-frequency SQUID with a 20-30 MHz pumping frequency is by a factor of 5 to 10 inferior to a similar low frequency SQUID. Based on the analysis of the SQUID noise, it was possible to improve the energy resolution by increasing the pumping frequency and the Q-factor of the resonant circuit. This was accomplished by using an amplifier which is described here. A schematic diagram of the amplifier is provided. The first stage of the amplifier is located in liquid nitrogen near the SQUID sensor at the end of the coaxial stub which performs the functions of a quarter wave impedance transformer. At 300 MHz resonant frequency, the passband width is 3 MHz, and the gain is 300. Figure 1, references 6: 5 Russian, 1 Western.

**Detachable Vacuum Coupler**

937K0023F Moscow PRIBORY I TEKHNIKA  
EKSPERIMENTA in Russian No 4,  
Jul-Aug 92 pp 205-206

[Article by L. I. Dzhordzhishvili, Georgian Academy of Sciences Physics Institute, Tbilisi; UDC 621.643.415+621.643.44]

[Abstract] A readily detachable vacuum coupler is described. The coupler can be used at temperatures of liquid helium, as well as at temperatures up to 250°C. It consists of a conical couple, sealed, depending on the temperature range, by a soap-glycerine jelly (in the cryogenic temperature region), a vacuum rubber gasket (in the room temperature region), or a gasket made of silicon rubber. The helium version was used for sealing the enclosure of a frequency-modulated spectrometer. The conical couple of this device, made of stainless steel, is fastened together by a coupling nut. The container tube, inserted inside the removable cone, forms a tub, which is filled with the jelly. With this conical vacuum coupler, it was possible to manually connect laboratory pipelines with a diameter from 10 to 25 mm. For coupling pipelines with larger diameters, wrenches must be used on both sides, which will only result in a reduced universality of this type of coupling, not changing the advantages of speed and uniformity of tightening along the entire circumference. Figures 2, references 4: Russian 1, Western 3.

**Shaper of Nanosecond Pulses for Electrooptical Laser Shutters**

937K0023G Moscow PRIBORY I TEKHNIKA  
EKSPERIMENTA in Russian No 4,  
Jul-Aug 92 pp 237-238

[Article by V. I. Berdnik, N. Ye. Bykovskiy, Yu. V. Senatskiy, V. A. Trifonov; UDC 535.241.13:537.228]

[Abstract] A shaper of nanosecond pulses based on a gas filled discharger of the ROU type was developed to control the electrooptic laser shutter on a  $\text{AlG:Nd}^{3+}$  crystal. In contrast to the familiar engineering solutions for high voltage modulators and dischargers with laser ignition, this device exhibits a simplicity of construction and has a small size. The shaper structure is described. The fundamental engineering characteristics of the shaper are: the amplitude of electrical pulses - from 2 to 10 kV; the pulse front duration - 0.5 ns; switching time - 0.3 ns; the ignition pulse amplitude - from 1 to 2 kV; maximum energy of the ignition pulse - 0.01 mJ; the ignition pulse duration - 10 ns; delay time spread of the discharger response - 1 ns; frequency of the discharger action (in a laser apparatus) - up to 10 Hz; the life-span - up to  $10^7$  switchings. Depending on the electrooptic cell connection and the discharger type, the shaper can be used for a single time or multiple Q-factor modulation in a laser resonator, as well as for synchronizing the performance of several electrooptic shutters, and for other modes of operation. Figures 2, references 3 Russian.

**Modern Methods and Means of Production Intensification and Product Quality Assurance**

927K0358A Moscow PRIBORY I SISTEMY  
UPRAVLENIYA in Russian No 7, Jul 92 pp 1-2

[Article by V.I. Kruglov, candidate of technical sciences, and L.N. Aleksandrovskaia, doctor of technical sciences, Moscow Institute of Aviation Technology imeni K.E. Tsiolkovskiy and All-Union Scientific- Technical Instrument Building Association imeni S.I. Vavilov; UDC 65.018.001.76:061.3]

[Abstract] A conference on modern methods and means of intensifying production and assuring product quality was held in Tuapse from 26 October to 2 November 1991, this All-Union conference having been organized jointly by the Moscow Institute of Aviation Technology and the Moscow Regional Administration of the All-Union Scientific-Technical Instrument Building Association. The conference was attended by 80 representatives of the RSFSR, Ukraine, Kazakhstan, and Azerbaijan, including 10 doctors of science and 30 candidates of science. The conference was divided into five sections, altogether 40 papers being presented for "round table" discussion. Papers presented by Section I on "comprehensive mechanization and automation of production by means of advanced manufacturing equipment and with the aid of computer facilities" emphasized the need for development of a system approach to analysis, design, and setup of production automation in

various branches of the national economy. Papers presented by Section II on "quality assurance during product development, product manufacture, and product maintenance in service" dealt with basically scientific solutions to problems of product quality assurance. Papers presented by Section III on "simulation and optimization of production processes" dealt with problems pertaining to construction of mathematical models and their use for process optimization. Papers presented by Section IV on "information technologies and training modes" dealt with these very topics. Papers presented by Section V on "mechanism of control during transition to market economy" dealt with mathematical models of the economy and of production control, essentially an extension of work done by Section I. Noteworthy in the entire presentation was the emphasis on education.

### Technological Retooling of Enterprises as Basis for Production Intensification

927K0358B Moscow PRIBORY I SISTEMY  
UPRAVLENIYA in Russian No 7, Jul 92 pp 2-5

[Article by A.N. Polyarus, candidate of technical sciences; UDC 658.27/29.001.7]

[Abstract] The principles of comprehensive retooling of enterprises for the purpose of increasing output of quality products on a competitive basis in a market economy are outlined, these principles being applicable the machine manufacturing and instrument manufacturing as well as to automobile and tractor manufacturing enterprises. The overriding aspect to be considered is the discrete nature of production processes. An essential requirement will be to convert the generally arrhythmical metal processing operations into rhythmical ones so as to avoid interoperational stockpiling and its detrimental effect on the turnover rate of production means, inasmuch as the profitability of an enterprise increases as the time for turning over tools from one operation to another becomes shorter. Successful solutions to such problems are introduction of flexible production systems along with program control, conversion to new automation of all processes. Following an engineering and cost effectiveness analysis of proposed retooling, three ways of solving the attendant production problems are identified. The first way is imposing heavier duty on parts processing equipment. The second way is mechanization of parts processing operations. Neither of these ways will lead to a substantial increase in production output. The third way is comprehensive mechanization and automation of all stages of the technological cycle, this quite lengthy and costly way being the only possible and effective one to eventually intensify production output. Figures 5.

### Methodology of Macrodesigning of Automated Production Systems

927K0358C Moscow PRIBORY I SISTEMY  
UPRAVLENIYA in Russian No 7, Jul 92 pp 5-7

[Article by L.N. Aleksandrovskaya, doctor of technical sciences, and V.M. Mironov, candidate of technical sciences; UDC 658.512.2.001.57: 519.711.2]

[Abstract] A set of mathematical models is proposed for macrodesign of automated production systems. For the first macrodesign stage, justifying the need for such a system, is proposed the Cobb-Douglas model. The simplest versions of this model are the single-product single-resource equation  $Y(i) = PX(i)^{\alpha}$  ( $Y$ —volume of production output in  $i$ -th cycle;  $P$ —productivity;  $X$ —resource spent on production in  $i$ -th cycle;  $\alpha$ —resource utilization factor) and the balance equation  $B(i) = pY(i)\beta(i)$  ( $p$ —unit production cost;  $\beta$ —demand factor). These two equations yield the nonlinear finite-difference equation of production development dynamics  $Y(i+1) = P(ap/c)^{\alpha}\beta Y(i)$  ( $a$ —percentage of profit invested in production). For the second macrodesign stage, maximizing the investment cost effectiveness in technological retooling, the Kolmogorov-Gabor polynomial is proposed as a model of the inherently stepwise retooling process. For the third macrodesign stage, selecting the optimum subsystem for installation, we proposed extension of the Kolmogorov-Gabor cost effectiveness model and usefulness-weight functions: subjective analogs of probability distributions of partial cost effectiveness indicators. The generalized usefulness function will serve as the overall probability indicator, its maximum value corresponding to the most rational combination of partial indicators and thus to the optimum subsystem variant. References 3.

### Optoelectronic Analog Angular Displacement Transducer

927K0358D Moscow PRIBORY I SISTEMY  
UPRAVLENIYA in Russian No 7, Jul 92 pp 15-17

[Article by O.D. Mikhatskaya, engineer, V.P. Plakhotnyy, candidate of technical sciences A.K. Smovzh, doctor of technical sciences, and V.P. Stepanchuk, candidate of technical sciences, Institute of Semiconductors at Ukrainian Academy of Sciences, Kiev; UDC 621.382]

[Abstract] An optoelectronic analog angular displacement transducer is described which consists of a position-sensitive photodetector, the functional equivalent of an electromechanical contact, a probing light source, and an optical fiber transmitting light from the source to the photodetector. The light sources is a light-emitting diode or superminiature incandescent lamp. The photodetector is a photosensitive layer on a substrate in the shape of a disk with a center hole, underneath an opaque rotor slug mounted on a shaft. It is, more precisely, the particular "spot" of that layer illuminated through the fiber which rotates and thus scans it in a circular motion controlled by the mechanism whose displacement is to be measured. The fiber runs through an oblique circular hole in that rotor and thus rotates with it around the shaft, while transmitting light to the photosensitive photodetector layer at a slant. All transducer components are contained in a light-tight cylindrical housing. The photosensitive photodetector layer is mounted on a circular substrate with a photoresistive interlayer and a collector layer which carries a uniform array of radial scanning potentiometer electrodes, all layers and the substrate having center holes for the rotor shaft. The efficiency of

this transducer is maximized by matching the emission spectrum of the light source with the photoconductivity spectrum of the photosensitive photodetector layer and matching the angle of light incidence on the photodetector surface (between the optical fiber and the photosensitive layer) with the angular half-width of the radiation pattern of the light source. The photodetector, the key component of this transducer, is designed into the optimum configuration and with best materials for this application. The effect of its structural discreteness is eliminated by exciting its elements in the positioning plane into vibration with an amplitude corresponding to the discretization period. The design calculations are based on an equivalent cascade network and have been programmed in the FORTRAN-4 language. The device was tested with SMN 10-55 lx and 100 lx incandescent lamps as well as with an Al 307 BM light-emitting diode. It has an angle of  $270^\circ$  or  $330^\circ$ , a positioning characteristic whose nonlinearity is 1 % without and 0.2-0.4 % with individual corrections, a speed limit of 600 rpm, an electrical resistance of  $(10-50) \pm 20$  % Mohm, a noise level of 4-5  $\mu\text{V/V}$ , and a life of  $10^7$  cycles. Its operating temperature range is  $-60^\circ\text{C}$  to  $80^\circ\text{C}$  and its power requirement is 20-40 mW. Its overall dimensions are 34 mm in diameter and 8 mm in height. Figures 2; references 10.

#### Development of Multilayer Inductosyns

927K0358E Moscow PRIBORY I SISTEMY  
UPRAVLENIYA in Russian No 7, Jul 92 pp 17-19

[Article by V.N. Volnyanskiy, engineer, Ya.A. Gassokh, engineer, A.A. Sogoyan, engineer, A.A. Ukhabov, engineer, and L.N. Safonov, doctor of technical sciences, Centyril Scientific Research Institute "Delfin", Moscow; UDC 621.314.214]

[Abstract] Technological requirements for series production of multilayer printed-circuit precision inductosyns are examined, single-layer ones already being produced by Ferrand and Valhama. One barely attainable key requirement is not to exceed the 0.2  $\mu\text{m}$  mean-thickness nonplanarity of the conductor layers, of the adhesive interlayers, and of the board, as well as to ensure that the thickness of the foil not vary beyond the 0.2  $\mu\text{m}$  limit. An extremely severe second key constraint on the conductors radially widening toward the periphery is a not larger than 4" r.m.s. deviation of their median lines and their angular widths from the respective mean values. An extremely severe third key requirement is that the radial eccentricity of the rotor windings relative to the axis of rotation not exceed 0.002 mm and the planes of the windings be perpendicular to the axis of rotation within a 0.4' tolerance (180 pole pairs). Two 2-phase 256-pole (128 pole pairs) inductosyns with double-layer rotor windings have been designed and built for digital automation systems, the IPU-20 being 21.8 mm long with a 164 mm outside diameter (80 mm stator OD, 62 mm rotor OD) and the IPU-23 being 26 mm long with a 225 mm outside diameter (117 mm stator OD, 117 mm rotor OD). Both operate with an excitation frequency of 2-16

kHz, the maximum phase signal at a 16 kHz excitation frequency and a 0.2 A excitation current being 8.6 mV. They were tested with a 22-digit angle-to-code converter, the latter having an angular resolution of 0.31" and its speed limit being 40°/s. Figures 1; tables 1.

#### Apparatus for Laser-Beam Scribing on Ceramic Substrates

927K0358H Moscow PRIBORY I SISTEMY  
UPRAVLENIYA in Russian No 7, Jul 92 pp 39-40

[Article by V.P. Umnov, candidate of technical sciences, S.V. Khurtov, engineer, and K.Ye. Sharonov, engineer, Scientific Research Institute "Kontrolpribor (Control Device)", Penza; UDC 666.3.022.41:681.7.069.24]

[Abstract] An apparatus for scribing on ceramic and glass-ceramic substrates with a laser beam has been developed. This apparatus includes automatic process cycling as well as automatic feed of blank plates and discharge of substrates ready for formation of thin-film and thick-film integrated circuits. The apparatus consists of a G-Oi-16-1 solid-state laser, an optical focusing and observation system, a coordinate plotter on a movable table with automatic positioning correction, an automatic loading-unloading manipulator which can handle 300 up to 1 mm thick plates, and a stepper-motor drive with controls. It also includes an automatic process programming and control module. The optimum table speed for cutting at least 50  $\mu\text{m}$  deep and 200  $\mu\text{m}$  wide grooves is 10 mm/s in discrete 10  $\mu\text{m}$  displacements; its idle speed is 80 mm/s. This laser-beam scriber is designed to cover a 48x60 mm<sup>2</sup> area, the maximum table travel being 200 mm in the X direction and 100 mm in the Y direction. The apparatus can operate at least 8 h continuously with subsequent 45 min pauses. It requires compressed air under a pressure of at least 300 kPa and an electric power of 12 kW from a 3-phase 220 V - 50 Hz network. Its overall dimensions are smaller than 0.875x1.1.160x2.20 m<sup>3</sup> and it weighs less than 600 kg. Figures 2.

#### Parallel Interface for Hookup of Measuring Instruments to IBM PC/XT Personal Computer

927K0358F Moscow PRIBORY I SISTEMY  
UPRAVLENIYA in Russian No 7, Jul 92 pp 32-33

[Article by A.L. Aleksandrov, candidate of technical sciences, L.V. Kozlova, engineer, and V.P. Reztsov, candidate of technical sciences, Special Design Office, Institute of Radio Engineering and Electronics at USSR Academy of Sciences, Fryazino (Moscow Oblast); UDC 621.317.725]

[Abstract] An interface for direct hookup of various measuring instruments to an IBM PC/XT or PC/AT personal computer is described, this interface being suitable for a greater variety of instruments and costing much less than the KOP interface card. Its board carries 24 data transmission lines, 8 instrument control lines,

also a sufficient number of lines for read-in and readout pulses facilitating communication with almost any kind of instrument through this parallel interface. Hookup with the computer is effected by three 8-digit registers: two input registers and one output register. The interface can be used for switching to remote control mode, for setting the type of measurement and the corresponding sensitivity limit, for setting the initial state, for starting a measurement, and for pickup of data readiness signals. These operations are initiated through four output ports: DATA, START, INPROG, SS (dump "data retention" signal). The interface was used for hookup of a V7-40 voltmeter to an IBM PC/XT computer, this instrument being connected to the interface through a TsPU-DU (digital program control - remote control) parallel adapter with an up to 15 m long cable. The test results indicate that users can include all four operations in their particular measurement programs. Figures 2.

**Performance of Field-Effect Transistors in Biosensors Under Conditions of Interference by External Light**

927K0358G Moscow *PRIBORY I SISTEMY*  
*UPRAVLENIYA in Russian No 7, Jul 92 pp 35-36*

[Article by A.N. Reshetilov, candidate of physical and mathematical sciences, V.V. Popov, candidate of technical sciences, V.N. Volikov, engineer, and T.P. Yeliseyeva, engineer; UDC 621.315]

[Abstract] An experimental study was made concerning the use of pH-sensitive ion-selective field-effect transistors with Ta<sub>2</sub>O<sub>5</sub> membrane in photosensitive biosensors

and their performance during changes in external illumination, such changes being the most common form of interference affecting these devices. Specimens of these transistors were formed on KDB-10(100) quartz plates by the planar process and ion-selective membranes were produced by oxidizing heat treatment of metallic tantalum films. After completion of scribing and assembly, the structures were hermetically sealed with a chemically stable varnish with only a sensing spot left bare. The chemical sensitivity of the thus produced field-effect transistors was within the 50-58 mV/pH range. The leakage current from the comparator electrode through the electrolyte to the substrate did not exceed 1  $\mu$ A, the voltage drift at the comparator electrode did not exceed 0.1 mV/h, and the low-frequency noise did not exceed 0.01 mV. The transistors were tested for behavior during change from artificial light (from OVS-1 fiber-optic luminaire) to daylight, during changes in level of light transmission by an analyzed medium, and during chemiluminescence. The intensity of incident light was measured with an LM-2 luxmeter. Input current-voltage characteristics of such a transistor in two different buffer solutions, with a pH 4.01 and a pH 9.18 respectively, were plotted in darkness and under a luminous flux of 30 mW/cm<sup>2</sup> intensity. Transistors were tested for dependence of the open-state photocurrent and the blocking-state photocurrent on the light intensity. The two sets of measurements made it possible to establish the dependence of the open-state photocurrent on the blocking-state photocurrent with the light intensity reduced to a parameter in this relation. Now the results of pH measurements made during changes in the light intensity can be properly corrected for parasitic effects such as the photocurrent induced by light absorption in the region under the gate and by the Ta<sub>2</sub>O<sub>5</sub> membrane. Figures 3; references 4.

**Model of Semiconductor With Variable-Composition Transition Region**

927K0352B Moscow MIKROELEKTRONIKA  
in Russian Vol 21 No 4, Jul-Aug 92 (manuscript  
received 10 Jun 91) pp 18-23

[Article by B.A. Zon, S.E. Kleymenov, A.N. Likholet, and S.V. Fetisova, Voronezh State University; UDC 621.382]

[Abstract] A model of an MDS'S structure (M—metal; D—dielectric; S'—semiconductor with variable composition; S—semiconductor) is proposed for calculation of its electrostatic characteristics. First is considered an S'S structure where the composition of the S' transition layer varies monotonically from the composition of the S layer at the S'S boundary ( $x = d$ ) to some other composition at the surface ( $x = 0$ ). The expressions for electron and hole concentrations are formulated in accordance with the energy diagram characterizing an intrinsic semiconductor (Fermi level equidistant from the bottom of the conduction band and top of the valence band) with a forbidden band which narrows from  $x = 0$  to  $x = d$  with an attendant decrease of the electron affinity energy to zero at  $x = d$ , assuming no degeneracy and ignoring changes in the effective masses of free charge carriers. An analytic relation for the electric field at the S'-S boundary is obtained from the solution to Poisson's equation for boundary conditions of a given potential at that  $x = d$  boundary and a zero potential at infinity. The voltage dependence of the integral excess concentration of minority carriers at the surface in MDS'S devices with such an S'S structure and the capacitance-voltage characteristic of these devices have been calculated on the basis of this model and, for comparison, also on the basis of a model which assumes local electroneutrality (O.V. Konstantinov, G.V. Tsarenkov; "Photoconductivity and Lambert Effect in Variband Semiconductors", FIZIKA TVERDOGO TELA No 4, 1976). As a physical model for numerical calculations we selected structures of the  $\text{AlAs}/\text{Al}_x\text{Ga}_{1-x}\text{As}/\text{GaAs}$  system with a  $d = 80$  nm thick transition layer and a 20 nm thick dielectric D layer ( $\epsilon = 12$ ), the parameters of the transition layer here varying linearly across its width in structures with  $x$  from 0 to 0.37, an energy gap within the 1.45 eV  $< E_g < 1.92$  eV range, and an electron affinity energy within the 4.07 eV  $< \chi < 3.6$  eV range. The proposed model yields a dependence of both majority carrier and minority carrier concentrations on both  $E_g(x)$  and  $\epsilon(x)$  distributions across the transition region. The model with assumption of local electroneutrality yields a uniform profile of electron affinity energy across that region and much less accurately approximates experimental data, especially the measured capacity-voltage characteristics. Figures 4; references 14.

**Analysis of Electrical Characteristics of LSI Circuit Components With Si-on-Insulator Structure by Two-Dimensional Numerical Simulation**

927K0352C Moscow MIKROELEKTRONIKA  
in Russian Vol 21 No 4, Jul-Aug 92 (manuscript  
received 2 Oct 91) pp 40-49

[Article by K.O. Petrosyants and M.V. Sycheva, Moscow Institute of Computer-Aided Machine Design; UDC 621.382]

[Abstract] A two-dimensional physical-topological model (A.A. Mishin; ELEKTRONNOYE MODELIROVANIYE, Vol 9 No 3, 1987) of SOI(Si-on-insulator)/MOS structures for LSI circuit components (transistors, CMOS inverters) was used for analysis of their current-voltage characteristics and of transient processes at their leads by numerical simulation, considering that these characteristics and processes depend on certain design parameters. For simulation we selected an SOI/MOS transistor with a 2  $\mu\text{m}$  wide and 2  $\mu\text{m}$  long  $n^+$ (source)- $p$ - $n^+$ (drain) channel between a 0.07  $\mu\text{m}$  thick  $\text{SiO}_2$  layer below the upper gate and a 1  $\mu\text{m}$  thick  $\text{SiO}_2$  layer above the lower gate, each  $\text{SiO}_2$  layer being separated from the respective gate by a Si film. The drain current-voltage characteristics were calculated on the basis of that model, using the method of finite elements for numerical solution of the equations of semiconductor physics in the diffusion-drift approximation with appropriate initial and boundary conditions: Poisson's equation, continuity equation, two equations for the net electron current and the net hole current respectively, each net current being the resultant effect of three generation-recombination mechanisms (avalanche multiplication, Auger effect, Shockley-Reid-Hall effect). The thickness of the Si films was varied over the 0.1-0.5  $\mu\text{m}$  range and the acceptor concentration in the  $p$ -region was varied over the  $5 \times 10^{15}$ - $3 \times 10^{16}$   $\text{cm}^{-3}$  range. Calculations were made for "thin"-film transistors and "thick"-film transistors, the drain current-voltage characteristics of the latter in the floating-potential mode exhibiting a "kink" effect and a static or quasi-static current "hysteresis" in the low-voltage range under a sufficiently high negative bias voltage at the lower gate. The two-dimensional distributions of the electrostatic potential and of the hole concentration demonstrate the accumulation of excess holes in the  $p$ -region. The results reveal a dependence of the current-voltage characteristics of SOI/MOS transistors for LSI circuits on the thickness of the Si layer and on the hole concentration in the  $p$ -region. They also reveal that the leakage current as well as the threshold voltage and the drain current-voltage characteristic in the prethreshold range of SOI/MOS transistor operation are influenced by the positive fixed charge on the lower Si- $\text{SiO}_2$  interface, the magnitude of this charge depending solely on the surface treatment and the resulting defectiveness of that interface. For a performance analysis of SOI/CMOS inverters, voltage transients during switching were also numerically simulated on the basis of that two-dimensional physical-topological model. Figures 9; references 18.

**Neural Network With Vertical Bloch Lines: Principle of Operation**

927K0352D Moscow MIKROELEKTRONIKA  
in Russian Vol 21 No 4, Jul-Aug 92 (manuscript  
received 11 May 91) pp 50-55

[Article by V.G. Redko, Scientific Research Institute of Materials Science; UDC 621.382]

[Abstract] A neural-like network with appropriate hardware is proposed for a heteroassociative memory on chip of VBL (vertical Bloch lines) devices (D.J. Willshaw, O.P. Beneman, H.C. Longuet-Higgins; "Nonholographic Associative Memory", NATURE, Vol 222 No 5197, 1969) and execution by it of the rather simple  $X_i \rightarrow Y_i$  mapping algorithm ( $X_i, Y_i$ —binary vectors whose respective  $x_{ij}$  and  $y_{ik}$  components are either 0 or 1). The network has the configuration of a matrix with modifiable elements  $s_{jk}$  at the intersections of rows  $j$  and columns  $k$ . Such an element, initially in the "0" state, transfers to the "1" state for memory operation in the record mode when there is at least one pair  $x_{ij} = y_{ik} = 1$ . In the reproduce mode a certain vector  $X_i$  is applied to the rows of this matrix, whereupon in each column is calculated the sum  $S$  of all  $x_{ij}$  products from  $j = 1$  to  $j = n_x$  ( $n_x$ —number of matrix rows equal to dimensionality of vector  $X$ ) and this sum is compared with a given threshold  $\Sigma$  which can be varied. On the output side of columns then appear the reproduced components  $y_k'$  (in state "1" when  $S \geq \Sigma$  or in state "0" when  $S < \Sigma$ ) of vector  $Y_i$ . Each column simulates a neuron and the modifiable elements simulate Hebb synapses. The mapping algorithm is generally most efficient and reliable when both vectors  $X$  and  $Y$  are "thinned", i.e., contain only fixed small numbers  $l_{x,y}$  of 1's in them ( $l_{x,y} < \log n_{x,y}$ ), the threshold is  $S = l_x$ , and the total number  $L$  of vector pairs does not exceed  $0.69n_x n_y / l_x l_y$  approximately equal to half the number of modifiable elements transferring to the "1" state. The proposed associative memory built with VBL devices contains a generator and a detector of cylindrical magnetic domains (CMD), an input-output register which codes information into presence or absence of such domains, a CDM→VBL/VBL→CDM switch, a linear array of storage registers which code information into presence or absence of VBL pairs within the walls of band domains, a linear array of adders, an adder shift register, and a linear array of CMD traps. Such a VBL memory should be able to map a large array of "thinned" multidimensional vectors ( $n_x \approx n_y \approx 30,000$ ), its capacity thus by far exceeding that of already built associative CMOS-device memories: one with  $n_x = n_y = 64$ , one with  $n_x = 96$  and  $n_y = 16$ ). Information processing and storage can, moreover, be combined within one memory chip. Another important advantage of such a chip is parallel operation, except for nonsimultaneity of vector  $X$  input and vector  $Y$  output. The author thanks Yu.K. Milyayev, V.A. Skidanov, and A.A. Frolov for helpful discussions, also V.L. Dunin-Barkovskiy chairing the seminar on neural networks and other participants of this seminar for discussing the material, and the reviewer for his critique contributing to improvement of the original paper. Figures 3; references 15.

# **Potential Capabilities of Bipolar Silicon S<sub>3</sub>LSI Base for Device Circuits Operating at Normal and Cryogenic Temperatures**

927K0352E Moscow MIKROELEKTRONIKA  
in Russian Vol 21 No 4, Jul-Aug 92 (manuscript  
received 15 Apr 91) pp 56-70

[Article by A.N. Bubennikov, Institute of Problems in Cybernetics at Russian Academy of Sciences]

[Abstract] The potential capabilities of modern submicrometric-size bipolar silicon transistor structures as S<sup>3</sup>LSI base for device circuits in high-performance computers and supercomputers operating at normal temperatures is predicted and this prediction then extended to their capabilities at cryogenic temperatures. The prediction is based on a numerical performance analysis of highest-speed circuit fragments containing unsaturated n-p-n and p-n-p transistor structures. Transient processes in standard circuit fragments ensuring maximum speed of logic elements at 298 K room temperature were simulated using the PSM TRAN2 (two-dimensional) and STRAN2 programs. As specific devices we considered: 1) common-base amplifier with reverse bias at the collector junction, 2) common-base emitter follower and a complementary emitter follower under a resistive-capacitive load each, 3) current switch with an inverting transistor and a noninverting transistor, under a short circuit and under a resistive-capacitive load. In order to ensure that both speed and gain will be the same or even higher at 77 K or lower temperatures (liquid nitrogen), it is not sufficient to simply scale down horizontal and vertical dimensions in a coordinated manner. Conventional scaling is inadequate because of several physical processes taking place at such low temperatures: 1) freeze-out of majority and minority charge carriers, resulting in undesirable higher surface resistance of the active base region and longer time constant of minority charge carrier accumulation; 2) narrowing of the forbidden band in an emitter with high impurity concentration, resulting in a lower gain; 3) undesirable tunneling and recombination in a strong electric field. It is thus necessary to optimize the design of scaled-down transistor structures for operation in the cryogenic temperature range. Both gain and speed can be maximized by producing thin-film structures with a low-concentration emitter and a high-concentration base or with an impurity concentration profile in the collector region which will minimize the effects of high injection level. Higher speed can be attained with a higher doping level in the base region and consequently higher mobility of minority carriers. A numerical simulation program KRIOTRAN facilitating optimization of transistor structures has been written based on Poisson's, continuity, and generation-recombination equations of the diffusion-drift model. This program was used for calculating: (1) the current-temperature dependence of the base surface resistance, of the current-transfer ratio, and of the emitter-collector time delay; (2) the dependence of the puncture voltage and of the time constant of minority carriers accumulation in the active normal mode on the width of the base with various maximum impurity concentrations in it. These calculations covered temperatures from 300 K to 88 K (1) and to 77 K (2). The design approach is extended to demonstrate the potential capabilities of microcircuit technology in producing cryogenic C<sup>3</sup>LSI circuits using paraphase differential logic elements with resistive loads and with diode loads. Figures 7; references 27.

### **Influence of P-Type Buffer Layer on Short-Channel Effects in Submicrometric-Size GaAs Field-Effect Transistor With Schottky Gate**

927K0352A Moscow MIKROELEKTRONIKA in Russian Vol 21 No 4, Jul-Aug 92 (manuscript received 12 Jul 91) pp 11-17

[Article by V.A. Gergel, Ye.Yu. Kulkova, V.I. Ryzhiy, and G.Yu. Khrenov, Institute of Engineering Physics at Russian Academy of Sciences; UDC 621.382]

[Abstract] Improving the performance of a submilli-metric-size GaAs field-effect transistor with a Schottky gate by inserting into its structure additional elements which will minimize the short-channel effects is considered, rather than improvement of the fabrication process so as to minimize the size of parasitic structural elements. The effectiveness of this method is demonstrated on addition of a p-type buffer layer to an n-channel GaAs SchGFET, the influence of such a layer on the electrical characteristics of the device being evaluated theoretically on the basis of an appropriate mathematical model. The model takes into account the far-from-equilibrium charge transfer within the active region with attendant nonlocal and nonsteady heating of the electron-hole plasma by an external electric field. The electronic plasma is described by solutions to both the two-dimensional equations of kinetics for one-particle electron distribution functions characterizing the various valleys in the conduction band and to Poisson's equation for the potential of a self-consistent electric field. The equations of kinetics were solved by the method of macroparticles, using the Monte Carlo method for simulating electron scattering by polar optical and intervalley phonons as well as by acoustic phonons and also by ionized impurities. Effects due to overcharge of deep electron traps in the semi-insulating substrate material, especially significant in a two-dimensional distribution of the electric field potential, were simulated by an original technique of using the stochastic method of macroparticles. The boundary conditions for Poisson's equation were stipulated in terms of source potential, gate potential, drain potential, and potential in the plane bounding the simulated region on the substrate side, this potential being determined by location of the Fermi level in the substrate material relative to the bottom of the conduction band. The equation was then solved by a direct method combining the algorithms of fast Fourier transform along columns and elimination in rows. The calculations have yielded: 1) the dependence of departure from the transistor threshold voltage and of the drain current on the acceptor concentration in the buffer layer, 2) the dependence of the transistor threshold voltage and of the efficiency of drain current control at the gate on the length of the gate length in a transistor with and without a buffer layer. The results indicate that a p-type buffer layer not only favorably influences the threshold voltage and the drain current of an n-channel GaAs SchGFET transistor but also suppresses short-channel effects in such

a transistor by cutting off charge carriers from the semi-insulating substrate and by redistributing the electric field potential so as to weaken the dependence of the threshold voltage on the gate length. Figures 5; references 16.

### **The Interval Method for Multiple Access to a Duplicated Monochannel of a Degrading Local Computer Network**

937K0022A Kiev ELEKTRONNOYE MODULIROVANIYE in Russian Vol 14, No 4, Jul-Aug 92 pp 18-21

[Article by V. A. Bogatyrev, Scientific Research Institute "Test", St.Petersburg; UDC 681.3]

[Abstract] Failproof property of the controlling local computing networks of the mainline topology is maintained by duplicating the monochannel, while in the process of degradation, the coherence (commutation capacity of the duplicated channel) is gradually lost. We examined an interval method of a multiple access to the duplicated monochannel, which takes into account changes of the subscribers coherence during the network degradation. For adaptation of the access procedure to the network configuration, which changes during the process of degradation, information about the subscribers coherence must be reflected in the network adapters. The method is based on separation of authority for the subscribers access in time, while each of the subscribers is allotted an interval permitting the transmission of signal packages. Figures 2, references 6 Russian.

### **Numerical Modeling of Physical Processes in Elements and Fragments of Silicon LSIC and VLSIC**

937K0022B Kiev ELEKTRONNOYE MODULIROVANIYE in Russian Vol 14, No 4, Jul-Aug 92 pp 49-56

[Article by I. I. Abramov, Minsk Radiotechnical Institute, V. V. Kharitonov, Gomel Polytechnical Institute; UDC 621.382.001]

[Abstract] The contemporary trends and problems are examined in the development of numerical modeling of physical processes in semiconductors. An integrated set of programs is described for a one-dimensional, two-dimensional and three-dimensional numerical analysis of elements and fragments of silicon LSI and VLSI circuits. Methods of simultaneous as well as consecutive concepts for the solution of nonlinear algebraic equations of a discrete model are used. The characteristic feature of the developed set of programs is integration in three different directions: a full integration in terms of dimensions, in terms of the software class, and in terms

of the initial statement of the problem. Results of modeling the physical processes for several characteristic structures are provided. Figures 4, references 46: 24 Russian, 22 Western.

**Computation of Reliability Indices of the  
"Protection Object-Safety Measures" System**

937K0022C Kiev *ELEKTRONNOYE  
MODULIROVANIYE in Russian Vol 14,*  
No 4, Jul-Aug 92 pp 66-70

[Article by A. I. Pereguda, Obninsk Institute of Atomic Energy; UDC 621.3.019.3]

[Abstract] Engineering systems have been developed with advances of complex technology, where a disruption of functioning can cause unforeseeable consequences. Safety systems are normally used for prevention of dangerous situations that can occur with such systems. If these systems fail, the operation becomes dangerous. A common class of engineering systems "protection object - safety measures" is examined, and relationships are provided for failure-free and uninterrupted performance indicators, suitable for a practical application. Mathematical models are developed for defining the reliability, which also take into account the consequences of failure. References 7: 6 Russian, 1 Western.

**Scientific Conference "Probabilistic-Physical  
Methods for Studying the Reliability of Machines  
and Equipment"**

937K0022D Kiev *ELEKTRONNOYE  
MODULIROVANIYE in Russian Vol 14,*  
No 4, Jul-Aug 92 pp 66-70

[Article by L. A. Zakrevskiy]

[Abstract] The 6th conference "Probabilistic-physical methods for studying the reliability of machines and equipment" was held in April 22-23, 1992 in Kiev. The conference was organized by the Republic house of economics, scientific and engineering promotion of the Ukrainian society "Znaniye", with participation of other Ukrainian associations, and the Ukrainian Academy of Sciences Institute of Cybernetics. Problems and results of studies in the area of probabilistic-physical methods were discussed. Many reports dealt with problems of certification. Features of estimating the reliability of microelectronic products were also discussed, and a method for determining the lower confidence limit of the average service-time of integrated circuits was described. Various software resources for analysis and for providing reliability were demonstrated. The next conference will be held in Kiev in 1994.

**Multiple Access Using Station Numbers for  
Conflict Resolution**

937K0012A Moscow *PROBLEMY PEREDACHI  
INFORMATSII in Russian Vol 28,*  
No 3, Jul-Aug-Sep 92 pp 27-39

[Article by; B. S. Tsibakov, S. P. Fedortsov, N. A. Ryleyeva; UDC 621.394.74-503.5]

[Abstract] An algorithm is proposed for access of signal packages into a communication channel with conflict resolution by using the station number. For simplicity, a system is examined where the number of stations  $M$  is a power of 2. Each station carries a number, whose binary representation consists of  $\log_2 M$  bits. The bit value, beginning with the highest order, is used for conflict resolution. When conflict occurs in a window  $t$ , the involved stations are divided into two subsets, depending on the successive bit of their binary numbers. Stations with a zero value of the bit, transmit in the window  $t+1$ , and the other stations wait until all stations from the first set successfully transmit their packages. Each station has an infinite buffer for storage of packages waiting to be transmitted. Two modified and two non-modified algorithms are described. In each of these pairs, the algorithms differ by the manner of terminating the series of successful transmission. In one case the end of the series is determined by the receiving station based on some bit value of the package, and in the other case by the absence of transmission in the channel. Figures 4, tables 4, references 8: 6 Russian, 2 Western.

**Asymptotically Optimal Discrimination of Several  
Hypothesis About Nonhomogeneous Gaussian  
Processes**

937K0012B Moscow *PROBLEMY PEREDACHI  
INFORMATSII in Russian Vol 28,*  
No 3, Jul-Aug-Sep 92 pp 54-59

[Article by; N. V. Verdenskaya; UDC 621.391.1:519.27]

[Abstract] This article examines the situation where the observed gaussian process can be essentially nonuniform, and the specified probability of error solutions are different. This is typical for a problem of signal detection and discrimination in noise, and also for signal detection problems in multichannel systems, when the hypothesis on the signal absence is admissible, and the probability of a false alarm is specified as being significantly smaller than the probability of confusion (missing). An asymptotic optimal inconsistent principle is found for discrimination of the hypotheses when the specified error probability approaches zero with an arbitrary speed. Its characteristic is determined and a comparison is made with the algorithm of a maximum likelihood. References 8: 6 Russian, 2 Western.

**Detection of Disorder in a Linear Stochastic System in a Noise Background**

937K0012C Moscow PROBLEMY PEREDACHI  
INFORMATSII in Russian Vol 28,  
No 3, Jul-Aug-Sep 92 pp 68-75

[Article by; S. E. Vorobeychikov, V. V. Konev; UDC  
621.391.1:519.27]

[Abstract] The problem of detecting changes in the properties of random signals is pertinent in many applications related to processing of time series, correlation and spectral analysis of data. A modified version of the

algorithm of cumulative sums is an effective method for detecting disorders in random processes with independent values, and also in the autoregressive processes. It is assumed that the process parameters before and after disorders are known. For the case of gaussian noise, equations are determined for the fundamental characteristics of the procedure: the average time between the false alarm and the average delay in detecting the disorder. A sequential procedure is constructed for detection of the parameter's changes in a linear stochastic system with a discrete time. The procedure requires no accumulation of data and can be realized in a real-time mode. References: 7 Russian.

### **Additional Relay Protection of Reactors and Power-Generating Units**

937K0005C Moscow *ELEKTRICHESKIYE STANTSII*  
in Russian No 8, Aug 92 pp 59-62

[Article by G. P. Stikhin, V. F. Chesnokov, Ural ODU;  
UDC: 621.316.925]

[Abstract] The existing standard solutions and regulations on relay protection and automatic control of the electrical power system's principal equipment breakdown do not always assure that the damaged or malfunctioning equipment is quickly and reliably disconnected. Two examples of this situation are cited. An emergency can arise at any high power station when the electrical contact with the power system is interrupted. If the high voltage switches are not activated, the power unit can start accelerating. Installation of additional protection will prevent this condition and is discussed here. When the regular remote controlled disconnecting equipment is malfunctioning, the additional power deactivating signal can be transmitted by a high frequency channel. The deactivation command is formed by the input relays of the reactor protection, which transmits a 600 Hz keyed, high frequency signal. At the receiving end, this manipulated signal is applied to the input of the automatic control device and, thereafter to the special unit with a relay, which disconnects the line. The decision about deactivation of the power unit or switching it to the idle run is made after estimating all characteristics and parameters of the boiler, turbine, and their regulating systems. Implementation of the additional reactor protection system requires no financial or operational outlays, because the element base of the already installed automatic relay protection devices is employed for this purpose. Figures 3.

### **New Two-Rate Form of Tariff on Electric Power**

937K0005A Moscow *ELEKTRICHESKIYE STANTSII*  
in Russian No 8, Aug 92 pp 2-7

[Article by A. P. Aleksanov, V. I. Denisov; UDC  
621.31.016.003.13]

[Abstract] Transition to a market economy provides conditions for the development of new types and forms of complex rates for electrical energy. Several possible methods of accounting are examined. A two-rate accounting for energy with higher payments for energy

delivered during the peak hours is considered as being the most objective. This approach would contribute to the stabilization of energy providers' profits and encourage the consumers to reduce consumption during the time of maximum load. A single rate system charging the consumers for not using the energy specified in the contract is equivalent to the two-rate system. These charges are computed based on the difference between the single-rate price list and the total fuel cost. Practically, the same results are produced as with the two-rate system, but in the minds of the consumers, charging for non consumption is associated with a punishment for saving energy. Figure 1, tables 2.

### **Analysis of Processes in Boxes of the VVER-440/V-230 Unit Under Breakdown Conditions With Loss of the Heat-Transfer Agent**

937K0005B Moscow *ELEKTRICHESKIYE STANTSII*  
in Russian No 8, Aug 92 pp 8-10

[Article by M. Marinov, Ye. Popov, B. Dmitrov, I. Khinovski; Energoprojekt, Bulgaria; UDC 621.311.25:  
621.039].004.6.001.572]

[Abstract] This study describes the results of studies dealing with processes in hermetically sealed rooms at the location of the explosion vents when linking the steam generator (SG) boxes of four Kozloduy nuclear power station (NPS) units by a connecting channel with a 15 m<sup>2</sup> cross section. It is assumed that the heat exchange agent is leaking from the first loop into one of the SG boxes caused by a breakage of the pipe-line with an equivalent diameter of 200 mm. This engineering solution is feasible at the Kozloduy NPS and it also allows using the sealed rooms of the boxes, which must be removed from operation when their service expires. A special computer program KHERMO was used for computation of changes in the heat exchange agent parameters in the rooms. The objective of the computations was to find an engineering solution for localizing the breakdown conditions. The analysis of the study indicates that a breakdown when a leakage is equivalent to a flow through an opening with a 200 mm diameter from the first loop of the V-230 reactor can be localized within the sealed rooms. For this purpose all sealed rooms of the units must be linked by channels. In the case of a two-way leakage, the localization of the break-down conditions is possible only by installing an ice condenser. Figures 5.

### Optical Heterodyning by CO<sub>2</sub> Laser in Atmosphere (Review)

927K0369A Nizhniy Novgorod IZVESTIYA  
VYSSHIKH UCHEBNYKH ZAVEDENIY:  
RADIOFIZIKA in Russian Vol 35 No 2,  
Feb 92 pp 103-129

[Article by A. M. Lisenkova, B. Yu. Khanokh; Byelorussian State University; UDC 621.373.826]

[Abstract] A heterodyne reception method of optical signals is very effective for registering reflected infrared optical radiation. The effects of atmosphere on laser radiation is characterized by attenuation of the radiation intensity due to absorption and scattering, by distortion of the electromagnetic wave parameters because of turbulence, and by refraction of the laser beam. A review-type analysis is made of the CO<sub>2</sub>-laser infrared radiation, propagating through a turbulent atmosphere of the Earth, including the analysis of prospects for constructing heterodyne range determination systems based on the CO<sub>2</sub>-laser. Quantitative estimates are also made of the environmental effects on the ultimate capacities of a laser locator under specific weather and atmospheric conditions in the transmission path of the optical signal. Figures 3, tables 8, references 154: 88 Russian, 66 Western.

### Field Energy Transfer Through Supercritical Waveguide Regions by the Wave of Boundary Perturbation

927K0369B Nizhniy Novgorod IZVESTIYA  
VYSSHIKH UCHEBNYKH ZAVEDENIY:  
RADIOFIZIKA in Russian Vol 35 No 2,  
Feb 92 pp 171-176

[Article by Ye. M. Gromov, V.M. Nakaryakov; Russian Academy of Sciences Institute of Applied Physics; UDC 533.951]

[Abstract] This study examines wave fields, which are described by the Klein-Hordon equations for a two-dimensional non-uniform waveguide, in the presence of a stationary wave of boundary perturbation. It was demonstrated that the energy transfer by the boundary perturbation wave through the supercritical for the initial modes waveguide regions is possible for both the volume and the surface modes. The volume modes are carried off by the waveguide expansion wave, moving with a velocity which is slower than the velocity of the plain waves in a homogeneous unlimited medium, that fills the waveguide; the surface waves are carried off by the waveguide contraction wave, moving with a velocity which is greater than the velocity of the plane waves in a homogeneous unlimited medium. In the case of the boundary perturbation waves propagation along a heterogeneous waveguide, the waves energy transfer is possible with changes of their frequency. This effect is common for all kinds of waves, and can be observed with different wave systems—in particular with a sound wave propagation in a near-surface acoustic channel in the

presence of a surface wave—or propagation of the electromagnetic waves in a non-uniform and non-stationary waveguide. Figure 1, references 7: 5 Russian, 2 Western.

### Zero Drift in a Fiber Ring Interferometer With a Lio Depolarizer and an Isotropic Fiber Circuit

927K0369C Nizhniy Novgorod IZVESTIYA  
VYSSHIKH UCHEBNYKH ZAVEDENIY:  
RADIOFIZIKA in Russian Vol 35 No 2,  
Feb 92 pp 189-199

[Article by G. B. Malykin; Russian Academy of Sciences Institute of Applied Physics; UDC 621.373.535.8]

[Abstract] A large number of fiber ring interferometers (FRI) are now being designed based on isotropic single-mode fiber lightguides (SMFL). Technically, it is much more difficult to manufacture high-quality beam splitters and polarizers from anisotropic SMFL than from isotropic SMFL. However, the FRI made of isotropic SMFL exhibit a large zero drift and a significant fading of the interference signal at the FRI output. The effect of a Lio depolarizer, made of two sections of anisotropic SMFL, on reducing the zero drift and contributing to the stabilization of the signal level at the FRI output was examined in this paper. The efficiency of employing the Lio depolarizer was compared to using a more simple depolarizer consisting of a single section of an anisotropic SMFI in the FRI circuit. It was demonstrated that the zero drift in the FRI with a depolarizer has no constant term and is caused by temperature variations, and that the advantage of the Lio depolarizer over a simple depolarizer lies in that it can simultaneously reduce the zero drift and prevent full signal fading at the FRI output. The value of the zero drift depends on the value of the coupling parameter of orthogonal linearly polarized modes of the SMFL, on the double refraction of the SMFL depolarizer, width of the spectrum, polarization characteristics, radiation source, and the polarizer's coefficient of extinction. Figures 2, references 13: 5 Russian, 8 Western.

### Improving Accuracy of Multipliers of Analog Signals

927K0367A Moscow IZMERITELNAYA TEKHNIKA  
in Russian No 6, Jun 92 pp 14-15

[Article by V.A. Korovin; UDC 681.335]

[Abstract] Pulse-type analog multipliers of two analog signals are considered for processing measurement data on high-speed or multipurpose microcomputers with adequate precision. They operate by forming a pulse signal with a duty cycle proportional to one input signal and an amplitude proportional to the second one. The mean value of the pulse signal leaving the low-pass filter on the output side is then proportional to the product of the two input signals. The basic device can be readily modified into a two-quadrant version for multiplying two signals when one of them changes sign and the other

retains its. It then suffices to obtain a pulse sequence with an amplitude proportional to that of the alternating signal and the same sign. Both constant and alternating components of the multiplier output signal will then vanish when the product of the two input signals is zero, which simplifies construction of the low-pass filter. In the four-quadrant version for multiplying two signals of different polarities there is formed a pulse sequence whose amplitude and polarity correspond to those of the first input signal. Its duty cycle is set to 0.5 when the second input signal is zero, larger than 0.5 when the second signal is positive and smaller than 0.5 when the second input signal is negative. The mean value of the pulse sequence is here also proportional to the product of the two input signals. Fluctuation of the multiplier output signal becomes significant when the useful signal or the product is small and especially so then the second signal is zero while the first one is not. To the resulting zero product will then correspond to the maximum amplitude of the formed pulse sequence and thus maximum fluctuation of the multiplier output signal. Inasmuch as a higher-order filter for suppressing this fluctuation will not only complicate the multiplier design but also lower its speed and thus its dynamic accuracy, special elliptic low-pass filters are needed for this purpose. Inasmuch as the structure of such filters is also quite intricate, an altogether different scheme is proposed which will ensure higher dynamic as well as static accuracy by reducing the fluctuation of the multiplier output signal to zero when any one of the two input signals is zero. This is achieved by means of a multiplexer with two information inputs and two address inputs, an inverter before one of its information inputs, and two comparators before its respective address inputs (V.A. Korovin, M.M. Kharaldin; USSR Patent No 1,231,519). Both comparators receive a triangular or sawtooth voltage signal from an oscillator. The first input signal, the one which determines the amplitude and the polarity of the pulse sequence, is transmitted directly and to one information input of the multiplexer and through the inverter to its other information input. The second input signal is transmitted to one of the two comparators, where it is compared with that triangular or sawtooth voltage signal and where then a pulse-width-modulated signal with a duty cycle proportional to the second input signal is formed. In the other comparator, meanwhile, is formed a rectangular meander signal with a 0.5 duty cycle. The duty cycle of the pulse-width-modulated signal is either smaller or larger than 0.5, depending on whether the second input signal is positive or negative (it is 0.5 when the second input signal is zero). The two comparators send each their output signal to the respective address input of the multiplexer. The multiplexer then sends, depending on the levels of the address signals, the appropriate information signal to the low-pass filter. A zero multiplexer output signal corresponds to either "0 0" or "1 1" address input signals. With either "1 0" or "0 1" address input signals, the multiplexer output signal is equal to either the first input signal or the inverted input signal respectively. The multiplexer thus indicates when the

output signals of the two comparators do not coincide. An experimental prototype of such a multiplier was built with microcircuits: series K140 (inverter, oscillator, low-pass filter), series K554 (comparators), series K561 (multiplexer). According to test results, its overall error including nonlinearity and null drift as well as output voltage fluctuation does not exceed 0.1 % within its 5 kHz passband for input signals with amplitudes up to  $\pm 5$  V. Figures 1; references 2.

### Certification of Laser Interferometers for Measurement of Linear Displacements

927K0367B Moscow IZMERITELNAYA TEKHNIKA  
in Russian No 6, Jun 92 pp 16-17

[Article by L.Yu. Abramova, V.M. Baratov, and V.L. Shur; UDC 715.1.089.6]

[Abstract] An apparatus and a procedure for certification of foreign-made and domestic-manufactured laser interferometers for measurement of linear displacements are being developed at the Scientific Research Institute of Metrology imeni D.I. Mendeleyev. The subject interferometer and the etalon reference interferometer are aligned along a common measurement axis. The laser of the subject interferometer and its beam-splitter prism together with a stationary reflector are mounted on a rigid base. The movable reflector of the subject interferometer and the one of the reference interferometer are rigidly mounted in the movable comparator carriage seating the reference interferometer, the vertices of these two reflectors exposed along the common measurement line. The reference interferometer includes a laser interference refractometer with a reflector inside a chamber for measuring the absolute refractive index of air. The standard of unit length is located in a room under thermostatic control maintaining the ambient air temperature constant within  $0.1^{\circ}\text{C}$ . The error of the reference interferometer does not exceed  $0.05\text{ }\mu\text{m}$  at the length of up to 1000 mm. The reference laser is a He-Ne/ $\text{I}_2$ -laser stabilized by way of saturation absorption in iodine. The apparatus also includes a photomultiplier with dynamic frequency conversion which acts as a recording photodetector, two plane mirrors (one semi-transparent) which mix the laser beams of both subject and reference interferometers on the cathode of that photodetector, an electronic frequency meter which measures the frequency difference between the two lasers, five other semitransparent plane mirrors, and a microcomputer. The following laser interferometers were already tested for certification: Hewlett-Packard models 5526A and 5528A for measuring displacements of up to 60 m; Soro (France) model "Metrilas" and Metra (Czechoslovakia) model La 3002 for measuring of displacements of up to 30 m; domestic models IPL MP and ILP-MP with a  $0.01\text{ }\mu\text{m}$  discretization step for measuring displacements of up to 60 m; domestic models IPL 30 with an LG 77 CW  $\text{CO}_2$ -laser and IPL 30K1 with an LGN 302 CW  $\text{CO}_2$ -laser for measuring displacement of up to 30 m. Figures 1; tables 1; references 6.

### Method of Estimating Relaxation Time for Deformation Vibrations of Correlation Platform

927K0367B Moscow IZMERITELNAYA TEKNIKA  
in Russian No 6, Jun 92 pp 21-23

Article by S.A. Vorobyev and S.Ye. Tabalin; UDC 534.833.008.6:681.7.068]

[Abstract] A correlation platform is considered for testing optical fibers used in communication systems and a method of estimating the vibration resistance of its base plate is proposed, the latter carrying the apparatus for such tests. The method involves use of a classical coherent optical correlator including a matched spatial filter, all its components being mounted directly on that plate. When the plate is deformed by vibrations propagating along the platform and the filter responds by oscillating harmonically in its plane perpendicular to the optical axis, then the correlator output signal will decay as the amplitude of those vibrations increases. Their decay time, an indicator of vibration resistance, can be estimated from the rate at which the autocorrelation function is reconstructed. The method is validated theoretically for harmonic random deformation vibrations with a uniform phase distribution density, using the probability density of such a process and the asymptotic expression for the corresponding Struve's function. The method was tested experimentally with a holographic correlator, the apparatus including an LG-52 CW CO<sub>2</sub>-laser as the light source, a spatial filter, a collimator lens, a projection slide, a Fourier objective lens, a matched spatial filter carrying the recorded Fourier hologram, an FD-7 photodiode-photodetector in the correlation plane, and an S8-13 high-speed oscillograph. Two tests were performed, each with a different dimension of the signal from the projector slide corresponding to an 8 mm wide slit and a 4 mm wide one respectively. A statistical analysis of the photodetector output data by the regression method yields a coefficient of the linear regression equations whose deviation from unity is not statistically significant, with a  $P = 0.9999$  probability for both tests. Figures 1; tables 1; references 10.

### Modulation Transfer Functions of Optical Fibers

927K0367D Moscow IZMERITELNAYA TEKNIKA  
in Russian No 6, Jun 92 pp 24-25

[Article by V.P. Daskalyuk, A.A., Ovchinnikov, V.A. Ponomarenko, and D.N. Prokofyev; UDC 621.315.2:535.8]

[Abstract] An analytical expression in the form of a finite triple sum is obtained for the intensity-modulation transfer function of an optical fiber retransmitting an optical signal from a radiator. This expression is based on the system of equations describing the state of a linear multiport network with "decoupled" inputs, this system of equations having the same form as the system of power equations for coupled modes. It is similarly solved by the method of double (s,p) Laplace transformation, taking into account the initial conditions. The transfer

function  $T_{ki}(s,p)$  for the  $i$ -th mode at the  $k$ -th output port depends only on physical and structural characteristics of the fiber, not on the excitation conditions. In order to obtain the overall transfer function  $T(l,j\omega)$  ( $l$ —length of fiber;  $\omega$ —radiation frequency), it is necessary to determine the intermodulation time and frequency characteristics. This is done by evaluating the matrix of intermodulation transfer functions for a fiber of given length  $l$  operating at a given frequency  $\omega$ . The algorithms of these calculations have been programmed in the PL-1 language, helpful for evaluating the dependence of the modulation functions of a radiator-fiber system on the intermodal coupling coefficients, on the power distribution among modes, and on the spectral width of optical radiation. Figures 2; references 4.

### Experimental Study of Thermal Electric Noise in Some Resistor Alloys

927K0367E Moscow IZMERITELNAYA TEKNIKA  
in Russian No 6, Jun 92 pp 35-36

[Article by B.N. Oleynik, V.V. Kukhar, V.A. Yereinskii, and N.A. Sokolov; UDC 536.5]

[Abstract] An experimental study of thermal electric noise in resistor alloys was made, two alloys with a different chemical composition and thus a different interatomic bond energy but the same crystal lattice as well as similar electrical and thermal properties having been selected for this purpose. An alloy of the Cr-V-Ga type was used as the base material. The alloy of one resistor contained Mo and Ge, most of which had been replaced respectively with W and Ga in the alloy of the other resistors. The electrical resistivity of the two materials was 1.52  $\mu\text{ohm.m}$  and 1.63  $\mu\text{ohm.m}$  respectively, with a temperature coefficient  $-8.4 \times 10^{-6}$  and  $-16.3 \times 10^{-6}$  respectively. The nominal resistance of both wires was 3.215 k $\Omega$ , their capacitance was 6.8 pF and 6.3 pF, their inductance was 0.62  $\mu\text{H}$  and 0.57  $\mu\text{H}$ . The resistors were mounted across the ends of a shielded stiff four-conductor link connecting them to the commutator switch of a 2-channel differential noise thermometer with a 100 kHz bandwidth, that switch also connecting them sequentially to an instrument preamplifier. Because the two thermometer channels could not be made perfectly identical, the effect of asymmetry was minimized by having the two resistors change places for each next 8-10 h-long test cycle. The readings of noise temperature were compared with the noise temperatures according to Nyquist's theorem. The results of ten tests revealed, at a 0.95 confidence level, that the R<sub>2</sub> resistor made of the alloy with a stronger interatomic bond had an approximately 0.03 % lower noise temperature than the R<sub>1</sub> resistor made of the plain Mo-Ge alloy. Discrepancies between the results of measurement and calculation may be due to structural nonhomogeneity of the resistor materials, imprecision of Nyquist's theorem, or unaccounted for systematic measurement errors. Figures 1; tables 1; references 10.

### Errors of Pulsed Ultrasonic Thermometers

927K0367F Moscow IZMERITELNAYA TEKHNICA  
in Russian No 6, Jun 92 pp 37-38

[Article by Ya.T. Lutsik, M.M. Dorozhovets, and I.S. Likhnovskiy; UDC 536.088:536.51:534-8]

[Abstract] The accuracy of a pulsed ultrasonic thermometer is analyzed, such as operating with longitudinal vibrations. The instrument consists of, besides the transmitter channel, a primary temperature transducer with a sensor, a null comparator which forms two short pulses whose falls correspond to zero-crossover of the incoming pulse, a shaper of an output pulse between the falls of those two, and a converter which multiplies the time interval equal to the duration of that output pulse by a reference frequency  $f_0$  and thus puts out a digital signal. The exponential dependence of the pulse duration  $t$  on the temperature  $T$  to be measured involves two also temperature-dependent parameters: thermal expansion coefficient of the sensor material and thermal coefficient of its Young's modulus. The product  $tf_0$  is transmitted from the converter-multiplier to an arithmetic unit for calculation of the temperature  $T$ , after the initial temperature  $T_0$  and the corresponding time interval (pulse duration)  $t_0$  have been calculated in it for calibration. The temperature is then read on the indicator scale. The measurement error of such a thermometer is determined by the error of output pulse formation and the error of its duration measurement, by the errors of  $T_0$  and  $t_0$  setting, and by the error which the arithmetic unit makes in calculating the inverse of time interval  $t = t_0 \exp[-0.5S(T) - 0.5S(T_0)]$ . To this must be added fluctuation and harmonic noise, also clutter caused by multiple reflections of acoustic pulses. Only fluctuation noise is considered in the analysis and for a thermometer with a tungsten sensor the measurement error is, at a 0.95 confidence level, estimated to be 2.8 % (signal frequency 100 kHz, nominal pulse duration 40  $\mu$ s,  $f_0 = 50$  MHz,  $T_0 = 100^\circ\text{C}$ ). In the ideal case of absent fluctuation noise the error is estimated to be 1.44 %. The error can be minimized by lengthening the sensor and thus the nominal pulse duration or allowing multiple reflections in it, by raising the reference frequency generated by the quartz oscillator, if this can be done without degrading the response characteristics of a TTL-Sch microcircuit, by increasing the word length in the arithmetic unit, by averaging the results of several consecutive measurements, and by adding a generator vernier pulses. Figures 2; references 8.

### Design of Electrodynamical Model of Alternating-Electric-Field Meter With Dipole Antenna

927K0367G Moscow IZMERITELNAYA TEKHNICA  
in Russian No 6, Jun 92 pp 45-48

[Article by V.I. Tokatly; UDC 537.8:621.317.32 (086.48).001.24]

[Abstract] An electrodynamic model of a selective alternating-electric-field intensity meter with a dipole antenna is constructed on the basis of the relation  $u_a E^0 = K_a V$  ( $u_a$  - unit vector along dipole axis;  $K_a$  - calibration factor;  $E^0$  - complex amplitude of electric field intensity;  $V$  - complex amplitude of voltage), assuming that the electric field alternates harmonically and that the dipole antenna alone converts the electric field into an alternating voltage. The instrument consists of an L-form dipole receiver antenna with a matching device at the free end of a horizontal cantilever rod supported by a mast, a voltmeter on a table, and a cable which connects the voltmeter to the matching device under the antenna by running up to the top of the mast. The receiver antenna is simulated by current generator, the current it generates being presented as the product of its admittance as a transmitter antenna and the equivalent EMF. The electrodynamic model reflects all components and their performance characteristics, including two air gaps between the enclosure of the matching device and each of the two arms of the L-form antenna respectively. Calculations based on the equivalent circuit diagram of such an instrument explain the asymmetry of field measurements, namely that different voltmeter readings are obtained when the antenna is oriented in two opposite directions upon being rotated through  $180^\circ$ . This factor is taken into account in the mathematical relation which serves as the basis of alternating-electric-field measurements with such an instrument and can also serve as the basis for an accuracy analysis of its readings. Figures 2; references 9.

### Design of Active Magnetic Broadband Antennas With Constant Conversion Gain Throughout Passband

927K0367H Moscow IZMERITELNAYA TEKHNICA  
in Russian No 6, Jun 92 pp 48-50

[Article by V.K. Lipskiy; UDC 621.396.67.1]

[Abstract] Tunable microvolts for measurement of weak magnetic fields over a wide frequency range require active magnetic broadband antennas, the simplest as well as most economical and reliable one being an antenna which includes a passive inductive converter, with a transformer, followed by an amplifier. The problem is to ensure not only that the conversion gain be frequency-independent and the converter sensitivity threshold be sufficiently low throughout the entire passband but also that the conversion gain nonuniformity not exceed the given admissible level and the converter sensitivity threshold be minimum at the lower corner frequency. The best way to achieve this is introduction of feedback, less desirable being addition of corrective networks in series with the converter or use of an amplifier with a low input impedance. The transformer is represented by a series LRC equivalent circuit on the secondary side, with the capacitance across the amplifier input. Two feedback schemes are considered: resistive

field intensity feedback from amplifier output to transformer primary or resistive voltage feedback from amplifier output to amplifier input. The first step in the design of such an antenna is selection of the ferromagnetic core from among available standard sizes. The second step is selection of the main winding for the magnetic receiver, namely determining the number of turns. The third step is determining the values of design parameters which will ensure the required conversion gain. The fourth step is determining the amplifier gain which will ensure a not larger than admissible nonuniformity of the conversion gain amplitude-frequency characteristic within the pass-band. The calculations necessary for solving these problems are made in accordance with antenna theory and the equivalent circuit for whichever scheme is considered. The fifth and last step is correcting the obtained values of the design parameters so as to make them fit into the exact expressions for conversion gain and sensitivity threshold. Figures 3; references 8.

#### Special Applications of Induction Generators

927K0366A Moscow ELEKTROTEKHNIKA in Russian  
No 6-7, Jun-Jul 92 pp 2-5

[Article by; S. P. Boyar-Sozonovich, Odessa Polytechnical Institute; UDC 621.313.332.001.8]

[Abstract] Functioning of the self-sufficient, capacitor-excited, low-power induction generators, and their advantages in application with pulsed systems are discussed. In addition to its simplicity of construction, one other significant advantage of such generators over synchronous generators, in the power range from 0.2 to 30 kW or higher, is its small size. It is pointed out that there is no possibility of over-voltage in pulsed systems with induction generators. This, however, can occur with synchronous generators. The normal mode of the induction shock generators is an abrupt activation to a load and deactivation. The nature of electromagnetic processes occurring with an abrupt activation is described by differential equations, for stator and rotor circuits. Conversion of a constant frequency into a varying frequency can be accomplished by using a single induction generator, with combined windings of the excitation and the generation circuits. The electrical diagram of an alternating frequency induction generator is provided and functioning of an induction generator in a parallel mode of operation is also discussed. Figures 4, references 7 Russian.

#### Electrical Strength of Polymer Insulators Under Impact of Short Voltage Pulses

927K0366B Moscow ELEKTROTEKHNIKA in Russian  
No 6-7, Jun-Jul 92 pp 34-37

[Article by; G. D. Kadzov, M. I. Sokolov, V. N. Ponomarev, N. B. Safronov; UDC 621.315.624.001.4]

[Abstract] The electrical strength of rod type polymer insulators under impact of high voltage, several microsecond wide pulses with a nanosecond front was experimentally investigated. The electrical strength measurement of rod-to-rod gap, gap between screen and screen, and 0.4-0.9 meter long thin-rod polymer insulators were made with a device generating 1.1 MV pulses with a 10-15 and 120 ns front. In addition to dry discharge voltages, the discharge characteristics of polymer insulators under natural rain conditions were also obtained. The results of the study are described, and a graph is provided showing curves of the discharge voltages as a function of the length of the insulating gap under impact of the negative polarity pulses. It was demonstrated that the discharge voltage along the insulating part of the air-gap and polymer insulators, under the impact of 10 ns/2  $\mu$ s pulses is not smaller than 12 kV, and is almost independent of the electrodes' configuration. The discharge characteristics of the gaps under impact of pulses with ns fronts, depend only on the pulse duration and are independent of the pulse front duration in the 10-120 ns range. Figures 3, table 1, references 3 Russian.

#### Vibrations of Magnetic Conductors of Transformer-Reactor Equipment due to Magnetostriction

927K0366C Moscow ELEKTROTEKHNIKA in Russian  
No 6-7, Jun-Jul 92 pp 40-43

[Article by; V. Ya. Gecha, L. P. Smirnova, V. V. Uryadnikov; UDC 621.3.042:539.4]

[Abstract] The vibration problem of the transformer and reactor equipment (TRE), that is, reduction of vibrations, noise, and forces transferred to the equipment's foundation is very pressing. One of the main sources of vibration is magnetostriction of the magnetic conductors' steel, which significantly depends on the steel type, and other factors. Devices are available for measuring the magnetostriction of the material, but they do not provide information on the steel magnetostriction in the manufactured magnetic conductors. A device for measuring the magnetostriction in magnetic conductors was reported previously. A short description is given in this paper of improved and more modern equipment, developed in the ALL-Union Scientific Research Institute of Electro-Mechanics. A method is also described for determination of vibration in the magnetic conductors, and equations are provided for computations. This method enables us to accurately predict the vibrations of the TRE's, while taking into account the manufacturing technology, to obtain a specified low level of vibration of the magnetic conductors at the manufacturing stage, due to a better manufacturing technology, and to improve the TRE's computation accuracy during the design stages. Figures 3, references 6: 5 Russian, 1 Western.

**Laboratory Model for Studying an Electrodynamic Suspension Device With a Discrete Track Structure of High-Speed Ground Transport**

927K0366D Moscow ELEKTROTEKHNIKA in Russian  
No 6-7, Jun-Jul 92 pp 62-64

[Article by; K. K. Kim, A. V. Kurakin, S. N. Tsigan, S. V. Vasilyev; UDC 629.1.006.001.57]

[Abstract] A rotating, coil-type electrodynamic support (EDS) model was developed and constructed in the Electrical Machine Department of the Leningrad Polytechnic Institute. Performance of the EDS is described for different sizes and number of excitation solenoids (copper, as well as superconducting), including short circuited coils, for different orientations of the excitation solenoids with respect to the plane of the track in the 0-35 m/s velocity range. The construction of the experimental model is described, and technical specifications are listed. The parameters and geometric dimensions of the superconducting solenoids are also provided. Using this model, and by applying the developed methods, it was possible to measure the mutual inductance between the excitation solenoids and the coils with an experimental error not greater than 5%, the secondary currents in the CTS and the forces with an error not greater than 7%, and 10%, respectively. One of the important results of the study, obtained with the device is the fact that the maximum of the force interacting with vertically oriented excitation solenoids was recorded at a non-zero transverse displacement with respect to the coil track structure (CTS). Curves describing the mutual induction changes between the excitation system and the CTS as a function of the transverse displacement are provided.

With two superconducting solenoids, the maximum of the magnetic coupling was recorded for a 5 mm transverse displacement. An identical displacement corresponded to the maximum of the levitation force of 10.3 H, with a 200 A excitation current in both solenoids and the CTS motion at 30.6 m/s.

**Electricity Conducting Rubber for Protection of Electronic Devices**

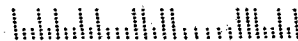
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No 6-7, Jun-Jul 92 pp 65-66

[Article by; L. L. Reznikova, L. N. Smorygo, A. F. Tikhomirov, O. I. Olshevskiy; UDC 621.315.55]

[Abstract] Metallic covers are used for protection of electronic equipment, computers and other devices from the effects of electromagnetic radiation. While electroconducting elastic materials are widely used for these purposes abroad, in the USSR these materials are not mass produced. Studies were made on the feasibility of developing strong, elastic materials with a high electrical conductivity and screening properties, capable of being converted into items of different configurations. A modified matrix of butadiene acrylonitrile rubber, exhibiting high strength and good thermal qualities was selected for this purpose. Physical and mechanical properties of the selected materials were examined and a material was developed, which can be used for protection of various electronic and electrotechnical devices from electromagnetic radiation in a wide frequency range. The material is suitable for use in different climatic zones at temperatures from -60°C to +120°C. Figures 3, table 1, references 2: 1 Russian, 1 Western.

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